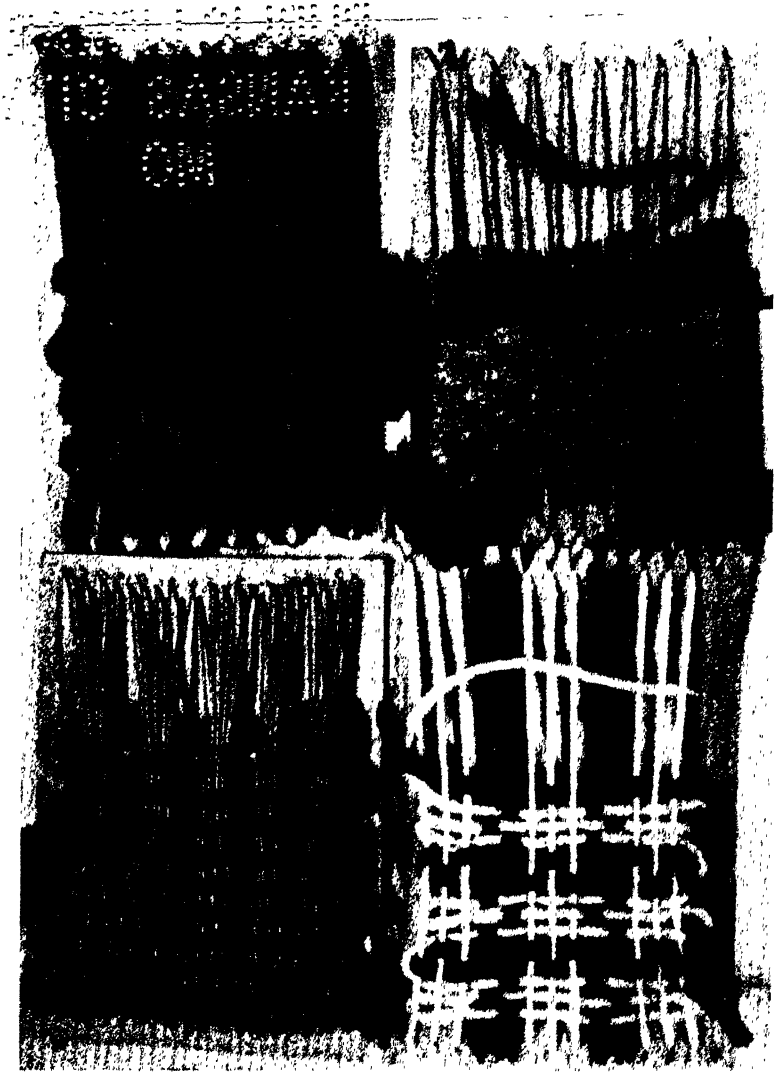

SAMPLES OF WEAVING PROCESSES

Warp and woof of same material.
Loosely woven to show process. (A)

Fine warp, wide spaced.
Warp completely covered. (B)

Fine warp, close set.
Coarse woof, almost hidden. (C)

Fine and coarse warp combined.
Woof repeats warp, giving checks. (D)

See description page 36

FIRST STEPS IN WEAVING

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"FIRST STEPS IN ART AND HANDWORK"

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FOREWORD

THIS book is planned to be true to its name. It is offered to those persons, young or otherwise, who wish to gain practical experience in the fascinating processes of weaving but know nothing of its terms, its tools, or its procedures. For this reason nothing is assumed; the author has endeavored to present the fundamental steps in very plain and simple terms. Nothing beyond these beginnings is offered because there are excellent books already available to those who have passed the first stages and wish to experiment with the many varieties of materials and procedures.

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HISTORIC BACKGROUND AND PRESENT APPEAL

WEAVING is one of the oldest industries. Its beginnings are shrouded in the mysteries of the prehistoric period. Its early processes can only be conjectured from very old samples found in caves and ancient tombs, which have been miraculously preserved through hundreds, probably thousands, of years.

Possibly the first crude beginnings may have come through interlacing branches across slender bushes to make a protection from the wind, when some wanderers found no cave for refuge. Possibly this procedure may have led to a similar interlacing of grasses to make a sort of garment.

As civilization progressed through long ages and wandering tribes settled down to more stable life, skill in weaving progressed to a marvelous degree. Finer and finer fabrics were made and dyed in beautiful colors. These skills represent infinite labor and patience in the use of crude tools. They also represent a high degree of creative ability and a fine appreciation of beauty in color and design.

Until comparatively recent times, still within the memory of our oldest inhabitants, all the clothing for the family was woven in the home on very simply constructed looms. Then came mechanical inventions which speeded the processes, and weaving went out of the home into factories. An epoch-making change followed. For untold generations children had grown up in the presence of all the tools and materials and were familiar with the processes which belong to the making of cloth and clothing. In a short generation or two all this was lost as common knowledge. Tools, materials, and processes were forgotten; even the vocabulary disappeared, for not only intelligent but highly edu-

cated people frequently ask: "Now, just what do you mean by *warp* and *woof?*" Not only did cloth become a mysterious something to be bought at a store, but in the later "ready-to-wear" era even the cloth is forgotten in the pleasure of a new frock, valued for its external appearance only.

Deprived of the active pleasures of the earlier period, people tried to fill their place with the passive entertainments of this machine age; but we wearied of these ere long, spurred by the urge within us to be doing. As a result, the creative impulse, a spark of the divine in each of us, began to seek new avenues of expression. In the search it came upon the lost art of weaving.

Children are fascinated by the discovery of the interesting history of their clothing and are eager to experiment with weaving processes. Adults are astonished at the simplicity of processes, which, though they produce fabrics charming in color and design, are still within the ability of just ordinary folk who are quite unaware of artistic ability yet conscious of a yearning desire to create beauty.

The miniature Indian Loom (page 3) suggests an excellent type of handcraft related to so-called regular subject matter.[1]

Creative expression in design and mechanical ingenuity in machinery have combined to produce some marvelous fabrics, yet the basis of each one is the combination of two sets of threads interwoven at right angles to each other.

What had flourished in the home as a highly essential industry, a medium of expression for the creative impulse and art appreciation, and had left the home to become a highly mechanized industry, now is coming back as a fine art and a hobby for leisure-time enjoyment. The rare old coverlets and other weavings of our great grandmothers are taking on new meaning and increased respect. We are studying those fine old designs and trying to re-create them.

[1] This illustration with an article by Miss Thorpe describing the procedure appeared in *School Arts*, Nov. 1936, under the title, "Navajo Weaving for School Children."

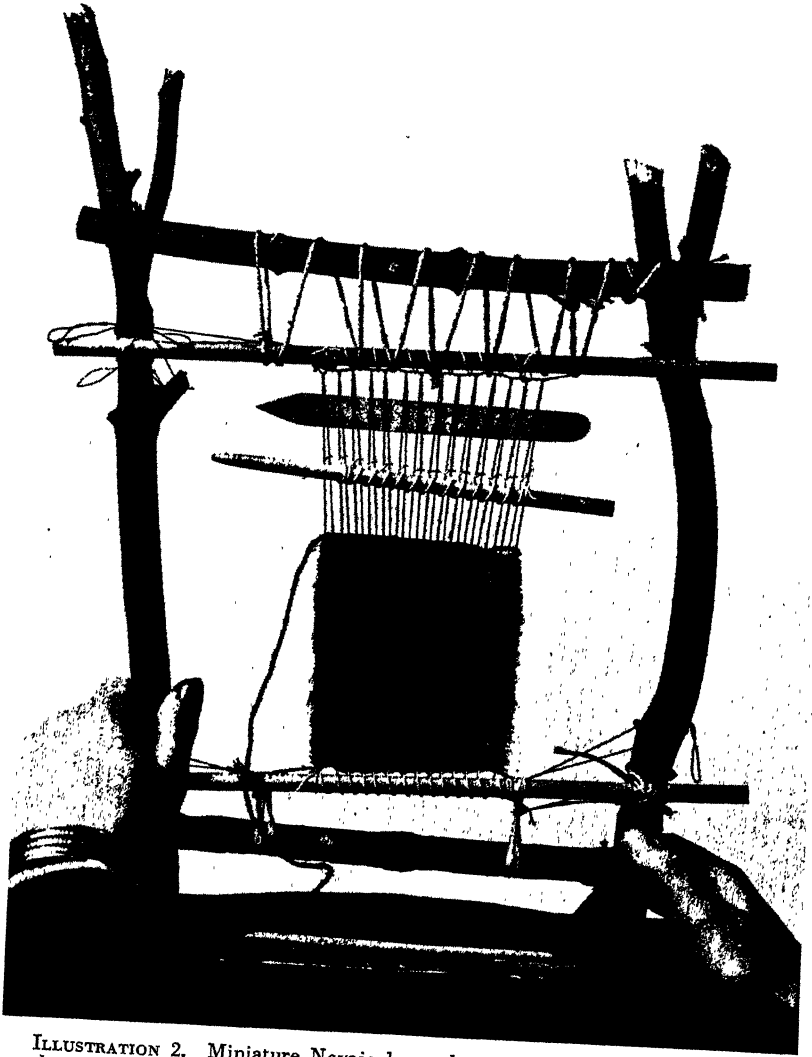


ILLUSTRATION 2. Miniature Navajo loom showing the way it is set up and the weaving in progress. A new color is being added. By children's class in Buffalo Science Museum. Courtesy of Buffalo Science Museum.

We are learning a broader interpretation of the term *art*. Only a few of us perhaps can ever learn to paint a picture, but many of us can experience the same thrill of creative expression in the manipulation of materials. Among the most fascinating of these creative processes we find weaving.

It is interesting merely as something to do which urges *just one more thread* and thus relieves nervous tension.

It is delightful for its possibilities in color harmony.

It is fascinating in its possibilities for design.

It has the satisfaction of producing a useful product.

But above all it gives the worker that supreme satisfaction: "I did it all by myself."

WEAVING AS A SCHOOL ACTIVITY

MANY years ago, with some misgivings, the author introduced weaving into her primary classes because it was one of the new activities. Its resemblance to darning was not in its favor; she thought the children would rebel at its monotony. Greatly to her surprise the children soon divided the week into "the days we weave and the days we don't weave." Almost any job could be put across with the reward of an extra weaving period. Such is the appeal to children.

Too often school activities have been chosen on a basis of popular fads and precipitated without due thought of fitness or proper preparation of equipment. As a result the discouraging outcome has been poor work, or lack of interest, or both.

Too often we have assumed that small fingers require small tools when larger tools are much easier to use.

Too often we have depended on interest in activity to overcome the handicaps of poor materials and makeshift equipment when a little foresight or a more equitable apportionment of funds might have produced vastly better results.

Too often more or less technical processes have been introduced by teachers who are unacquainted with essential technics, and little distinction has been made between activities in which the chief value lies in the child's spontaneous efforts and those in which satisfaction depends upon the mastery of certain fundamental processes before the worker can achieve his purposes and desires with any degree of success.

Weaving belongs to this latter class. There are processes which should be definitely taught—not discovered nor guessed

at. These processes can be most easily learned through the use of relatively large weaving frames and coarse material. If economy is necessary empty wooden boxes may be used or weaving frames may be easily constructed from scrap lumber. Common twine may be used for warp and rags for woof. The total expense will be scarcely more, perhaps less, than the cost

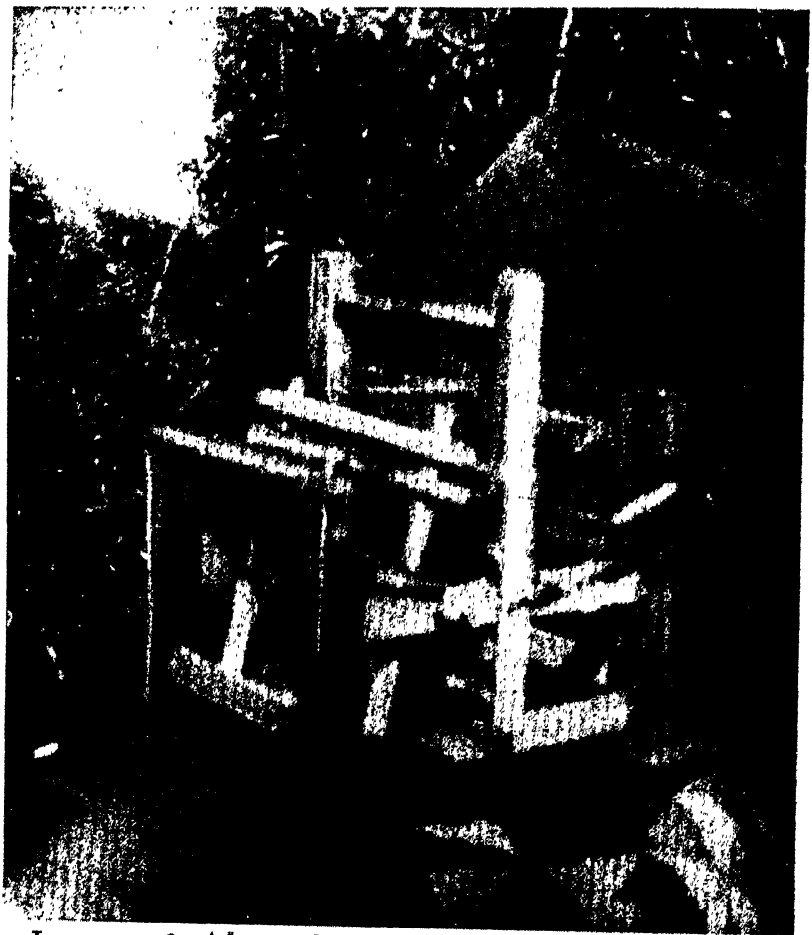


ILLUSTRATION 3. A loom made by a small boy in a rural school in southern Missouri. He took as his pattern his grandmother's loom, because she "wove beautiful rugs."

of cardboard and yarns often used in a mistaken sense of economy; the result will be a greater comprehension of processes together with less eye strain and less nerve tension.

Too often in the introduction of school activities which involve the manipulation of tools and materials we have all but forgotten the learner in our interest in logical procedure in the subject taught. We have forgotten to "begin where the child is" in a psychological attack based on his needs and interests.

As an instance of the experience noted above, a certain second-grade boy labored many days weaving a *rug* in the school colors for his room. He had just been promoted to the dignity of a room to himself. At last the *rug* was finished and laid on the floor. As he worked, he had been seeing with his mind's eye, not what he was working on, but what the word rug usually connotes. As he set one foot on this miniature production (It would accommodate only one foot at a time.) he exclaimed: "Gee, ain't it little!" Nevertheless the precious creation was taken home and put beside the bed in his new room, and, on the word of his mother, he never got in or out of bed without setting one foot upon it. But his teacher registered a vow to continue experiments until a way could be found through the use of larger equipment and coarser material to make the same amount of energy produce something more satisfying. (The illustrations on pages 8 and 9 show some of the fruits of that vow.)

Illustrations 4 and 5 show examples of weaving done on frame looms similar to the one shown in Illustration 4. The pillow frames were 18 x 18 inches. The rug frames were 18 x 36 inches. The materials used were rovings, soft-twisted jute, and raffia. Each pupil planned his own pattern and set his warp accordingly. The maker of the first pillow in Illustration 4 was quite chagrined when he forgot to "weave as drawn in." For the process of making cords to finish pillows see page 74.

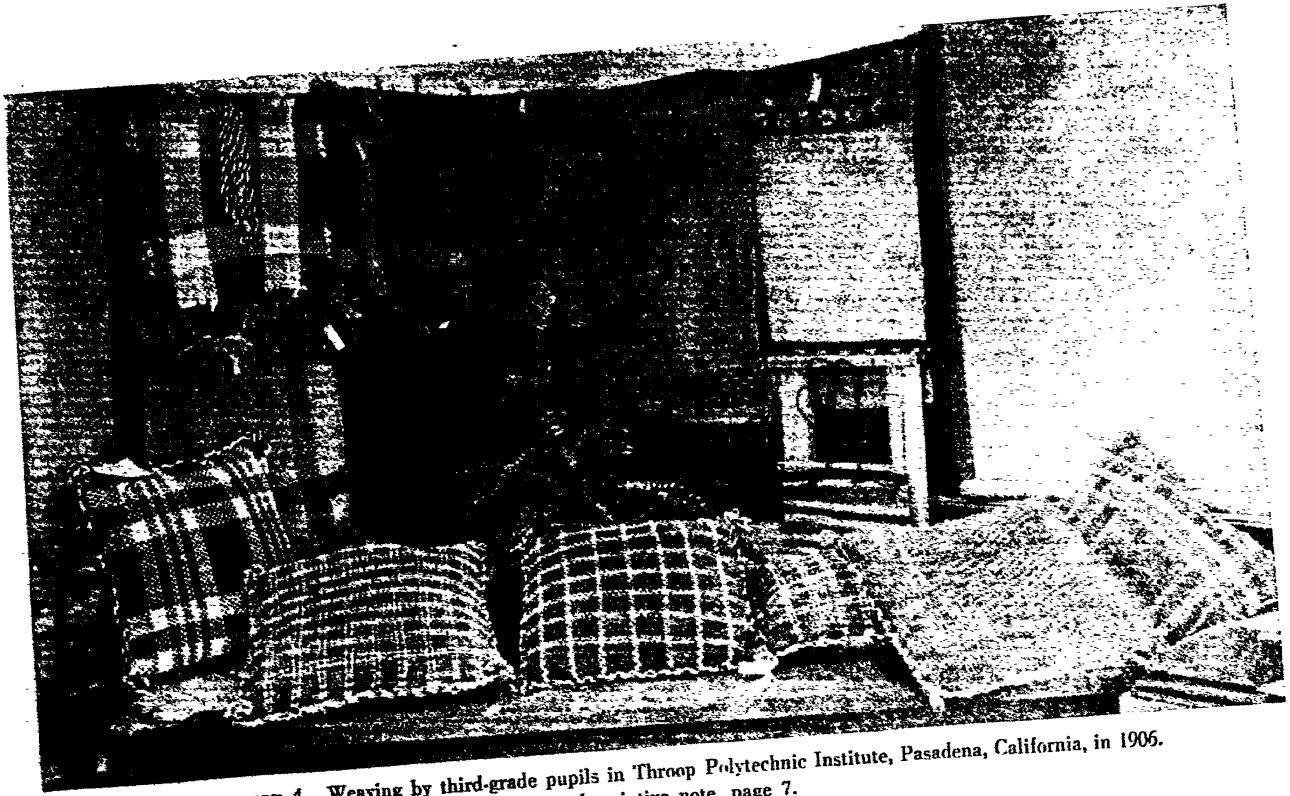


ILLUSTRATION 4. Weaving by third-grade pupils in Throop Polytechnic Institute, Pasadena, California, in 1906.
See descriptive note, page 7.

ILLUSTRATION 5. Weaving by fourth- and fifth-grade pupils in Throop Polytechnic Institute, Pasadena, California, in 1906. See descriptive note, page 7.

WEAVING TERMS

WEAVING processes have inherited from a long past an interesting vocabulary. These terms are important not only for an understanding of the literature of weaving but are to be found in poetry and prose, in symbolic relationships, as "the warp and woof of life", "the loom of experience", and similar expressions. While pausing in writing these words to glance at incoming mail, the author caught these words in a current magazine: "At night the railroad whistle is the shuttle on a magic loom that darts back and forth through the web of memory, weaving a many-colored pattern."

These terms have come down to us from many sources and in some cases several terms for the same tool or process are equally common.

The first group of terms we meet relate to the threads which are to be woven. The foundation threads, which must be stretched on some sort of frame, are called *warp*. Because in measuring warp it is often crocheted into a *chain* to prevent tangling, this term is used by the carpet weaver almost as commonly as the term *warp*. The threads which are woven into the warp and at right angles to it are called *woof* or *weft*. Also as a companion to *chain* the carpet weaver uses the term *filling*, *chain and filling* being synonymous with the more common expression, *warp and woof*. The cloth produced by weaving the woof into the warp is called the *web*.

Another group of terms refer to the *loom* and its parts. The term loom is used for any apparatus on which weaving is done. Its first essentials are the *warp beam* on which a supply of warp

is wound, and the *cloth beam* to which the warp ends are tied. As weaving proceeds, the woven cloth is wound on the cloth beam and the warp is unwound from the warp beam. The next essential is a means of separating the warp threads to allow the woof to pass through. This opening is called the *shed.* This is most commonly accomplished by the use of heddles, a *heddle* being a sort of needle with an eye in the middle through which a warp thread is strung. The heddles are carried on a frame called a *harness.* For a plain weave two harnesses are needed, one lifting the *odd* threads and one lifting the *evens.* Some harnesses are operated by *treadles,* which by foot pressure pull the harness down. Other looms have *levers* which pull the harness up, either process opening the *shed.* The woof or filling is wound on a *shuttle* to make it easy to throw the thread through the shed. Each thrust of the shuttle is called a *shot.*

Another important part of the loom is the *beater,* which is a frame containing a row of vertical bars, usually of steel, set about one eighth of an inch apart. The beater is set in front of the harnesses and swings back and forth to *beat* the woof into place. In olden times the bars were often made of bamboo splints or other reeds and the *beater* is also called the *reed.* Another old name for it is *sley.* The bars are set at regular intervals leaving spaces called *dents.* 12, 15, or 20 dents to the inch are most common. The warp is strung through the dents and thus held in even spacing.

In order to make the warp wind on the beam several plans are used. Frequently a folded cloth called an *apron,* is tacked to the beam and the warp tied around a rod slipped through its folded edge or the rod may be tied to the beam by strong cords.

Another group of terms refer to the *texture* or character of the finished web or cloth. The warp may be strung to produce an open or close *mesh* according to the number of threads in each dent. For a filmy scarf only every other dent might be used. For smooth texture all warp threads must be *taut,* or tightly drawn

across the beams. Any *slack* or loose thread will spoil the effect.

In order to secure a firm edge the six or eight warp threads on each edge are set closer together to form a *selvedge*.

For convenience in reference an alphabetical list of definitions follows:

Apron—A folded piece of muslin, its ends tacked to the beam and its folded edge having slashes or eyes about one inch apart through which warp threads are tied around a bar which is slipped between the folds of the cloth. Sometimes a heavier bar attached to the beam by cords is used instead of the apron. In either case the purpose is to facilitate tying the warp and insure having it roll tightly around the beam. (See Illustrations 25 and 26, page 50.)

Beater—Also called *reed* and *sley*. A frame having vertical bars (usually of steel), set at equal spaces, commonly about one-eighth inch apart, used to press the woof thread evenly into place.

Cloth Beam—The part at the front of the loom to which warp threads are tied and on which the cloth is wound as woven.

Comb—On a weaving frame a coarse comb may be used as a beater, or a convenient tool may be made by driving small nails into the edge of a small rectangular stick.

Dents—The space between the bars in the beater. Warp threads are strung through the dents and thus held in even spacing.

Dowel Rod—Round stick of hard wood, made in many sizes. Its original use was to fasten joints in cabinet making, but it has served many other purposes.

Drawing-in-hook—A long thin blade hook used for drawing the warp through the heddle eyes and dents.

Harness—A frame together with the heddles which it holds in place.

Heddle—One of a set of parallel double cords or wires, with an eye in the middle. Each warp thread is drawn through the eye

of a heddle. (See Ill. 00) Modern commercial heddles are generally of cut steel or twisted wire.

Lease Sticks—Two thin pieces of wood or other board inserted between the harnesses and the warp beam to separate the *odds* and *evens*. The sticks are usually tied by long loops to the warp beam to keep them in place. In addition to giving more even tension to the warp threads, any twists or knots in the warp will be caught against the outer stick where it can be easily adjusted. Otherwise it may slip unnoticed against a heddle and the thread be broken.

Lever—On a table loom each harness is attached to a lever and is raised and lowered by hand.

Loom—The apparatus on which weaving is done. Its form varies from two parallel sticks to very intricate machines.

Mesh—The space between woven threads.

Overshot Weave—The process of weaving with a rhythmic irregularity in the skips which produces a pattern.

Plain Weave—The process of weaving alternately under ones, over ones, without skips.

Ratchet—Notched wheel used in holding warp and cloth beams firmly in place.

Reed—Same as beater—above. Bars were formerly made of reeds. The *reed* is set in a swinging frame which, when swung forward, *beats* the woof thread into place.

Selvedge—From *self-edge*. Also spelled *selvage*. The closely woven space along the edge of cloth to give firmness. Secured by setting warp threads closer together, by drawing in more threads to the dent, or by doubling three or four threads on the edge of the weaving, or by both of the two latter methods.

Shed—The triangular space between two sets of warp threads (odds and evens) made when one harness is lifted and the other depressed. The woof or filling is drawn through the shed by the shuttle.

Note—On a two-harness loom the odd-numbered warp threads

are drawn through the heddles on one harness and the even numbered threads through the other, alternately.

Shot—One passage of the shuttle and woof thread through the shed.

Shuttle—The stick or frame on which the woof is wound in order to carry it easily through the shed.

Slack—Loose and uneven.

Sley—Same as beater and reed. Term used most commonly regarding the number of threads to the dent, as "Sley thirty threads to the inch." Reeds are made with different spacings, thus giving more and fewer dents to the inch, 12, 15, and 20 dents being common. Directions for setting up a weaving pattern usually include the number of threads to the inch to give the best effect. Two threads to the dent on a 15 dent reed would give thirty threads to the inch.

Splicing—Method of joining ends of woof or warp threads by overlapping or tying.

Tabby or Binder Thread—Used with the overshot weave which makes a plain weave background to give strength to the overshot weave.

Taut—Firm and tightly stretched.

Tension—The tightness or looseness of warp threads when stretched ready for weaving.

Textile—A general term applied to any woven material. *Fabric* is a similar term.

Texture—The character of woven material.

Treadle—On a foot-power loom each harness is attached to a treadle. This permits operation by the feet.

Twill Weave—The process of weaving with regular skips, as under one, over three, in which diagonal lines are formed across the texture.

Warp—The threads which run lengthwise of the cloth. Also called *chain*. The warp is stretched firmly on a frame called a *loom*.

Warp Beam—The part at the back of the loom on which the warp is wound.

Web—The cloth which results from weaving woof threads into the warp.

Woof—The threads which are woven in and out across the warp. Also called *filling* and *weft.*

THE WEAVING PROCESS

Darning is the simplest weaving process and the most tedious. Darning involves two steps or processes. First, foundation threads are drawn back and forth making evenly spaced parallel lines. These foundation threads are the *warp* of the weaving process. In the second step another thread is woven in and out across the foundation or warp threads and at right angles to them. The needle picks up every other warp or foundation thread (1-3-5-7 etc.) and the weaving thread is drawn through. Returning in the opposite direction, the *under* threads (2-4-6-8) are picked up and the thread drawn in. These two steps are repeated indefinitely until the space is filled.

The *Plain Weave.* When the threads are evenly spaced in each direction the result is a square-meshed web. This is a plain weave identical with muslin, burlap, and countless other fabrics, some coarse, some fine. Many variations are possible through the use of different materials such as combining fine and coarse threads or combining different colors, without changing the actual process of the plain weave.

The plain weave may be modified in *texture:*

A—By making wider or narrower spaces between warp threads. Wide spacing allows the woof to be beaten closer together, often covering the warp entirely, as in Navajo Indian blankets. Narrow spacing emphasizes the warp, often completely covering the woof and producing a corded effect, the cords running across the material. Certain dress goods (such as poplin) are woven in this way.

B—By striping the warp through using alternating bands of

coarse and fine warp. When the variations used in the warp are repeated in the woof, checks and plaids result.

C—By fine thread for warp with a coarse woof. Example, carpet warp with rags, candlewick, or rovings commonly found in rugs.

D—By coarse thread for warp with fine woof. This gives a corded effect with cords running lengthwise.

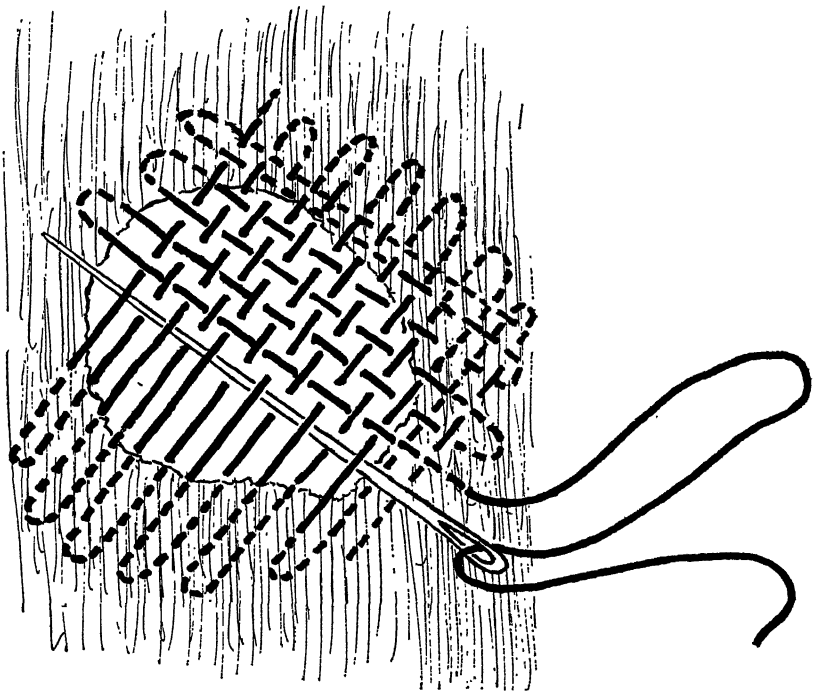


ILLUSTRATION 6. Darning as the basic weaving process.

The plain weave may be modified in *color:*

A—By using different colors in the woof, giving color stripes across the material. The variety of combinations of wide and narrow stripes is limited only by the inventive powers of the weaver.

B—By using two or more colors in the warp. This will give stripes lengthwise of the material. When the same variation in color is used in the woof, checks and plaids are produced. Gingham is a common example.

C—By using two colors alternately in the woof. This will give color stripes lengthwise of the material. The width of the stripes may be varied by using over one, under two, or other groupings.

D—By using two or more colors in the woof and weaving part way back and forth with each color, forming color spots which may be varied in shape to make a pleasing pattern. Navajo rugs are woven in this way.

The *Twill Weave* is a slight variation of the plain weave which emphasizes diagonal lines in the texture seen in serges and flannels. In the darning process it may be secured, for example, by picking up on the first shot every fourth warp thread—i.e. 1, 5, 9, 13, etc.

on the second shot—2, 6, 10, 14,

on the third shot—3, 7, 11, 15,

on the fourth shot—4, 8, 12, 16.

The fifth shot would again take the same threads used in the first shot. Continued indefinitely, the result is long-spaced woof threads and short-spaced warp threads which form diagonal stripes across the material. The effect may be varied by using combinations other than under one over three. The effect may also be varied by reversing the direction of the diagonal line through changing the order from 1, 2, 3, 4, to 4, 3, 2, 1, at regular intervals, for example, every twelve shots. This will give a zigzag effect used often in men's suitings.

Twill weaves may be made double faced by using two colors. Color No. 1 sets the pattern, color No. 2 picks up the threads in reverse—i.e., under 3 over 1, in the pattern described above. The result will show much of No. 1 and little of No. 2 on one side and reverse emphasis on the other side.

The *Overshot Weave* follows the principle of the twill but in

irregular order to form definite patterns. The overshot and twill weaves call for at least a four harness loom and the effects depend upon the pattern used in threading the heddles described on page 65.

TYPES OF LOOMS AND WEAVING FRAMES

THE first requisite for weaving is a means for stretching the warp threads taut and firm. Various commercial looms are, of course, available.

For homemade apparatus an empty wooden box may be used and the threads stretched across the open top around nails driven in the heavy end boards. Or a frame of any desired dimensions may be made according to the diagram, page 25. For first work on either of these, the nails may be set one-fourth inch apart and the warp strung around two nails at each end, thus setting the warp threads one-fourth inch apart. After some practice, if finer weaving is desired, stringing the warp around one nail will set the threads one-eighth inch apart. For small pieces of weaving a piece of cardboard may be used. The warp may be strung around notches cut in the ends of the card or through holes. (See Illustration 20.)

The box loom (shown in Illustration 7, page 21), is provided with movable beams made from broomsticks. The right hand or warp beam is held in place by a dowel pin and peg. The cloth beam is held firm by a ratchet and pawl. The warp is strung through a cardboard heddle frame. Illustration 11 shows a similar heddle of wood. The weaving frame at the left shows the shed opened in the warp by a flat stick. The weaving comb below shows the nails set along the edge of the stick. Illustration 15 shows the same loom with string heddles.

In order to weave long strips of cloth many practices have inspired many inventions.

Some primitive peoples still tie long warp threads to a post

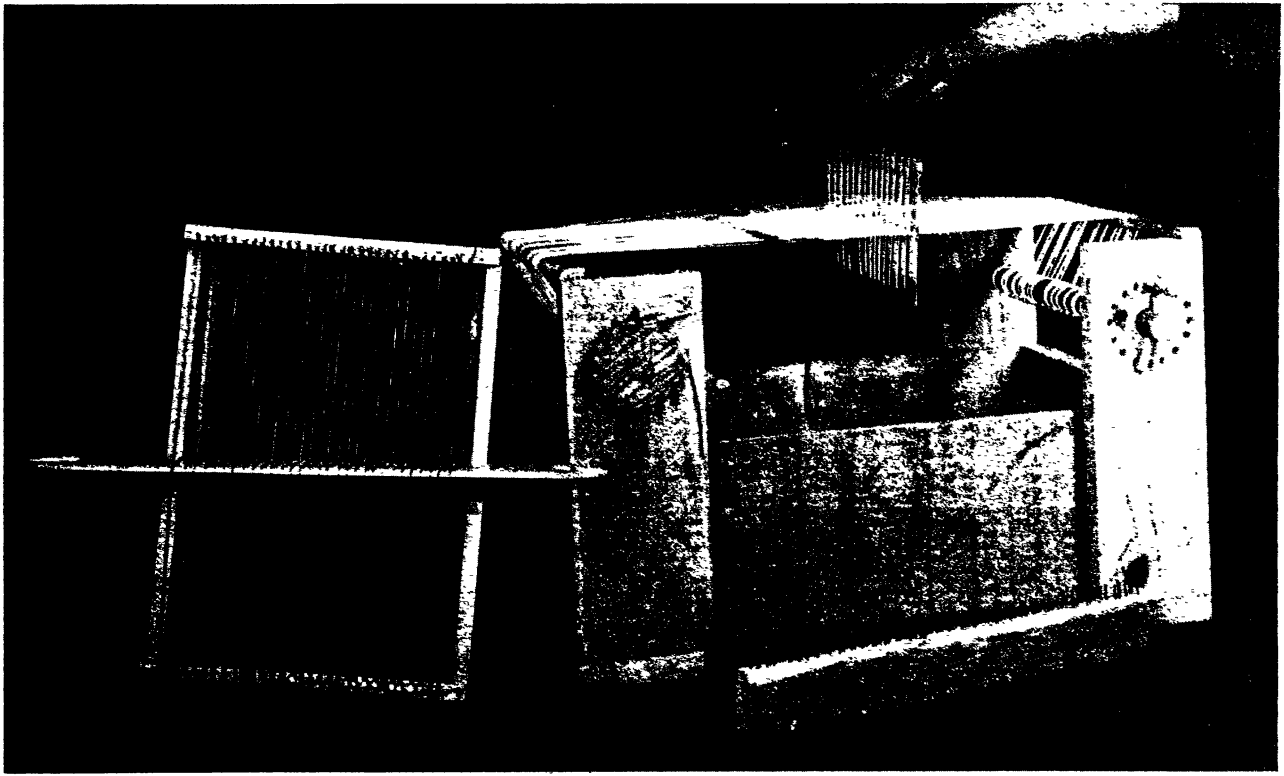


ILLUSTRATION 7. Homemade box loom, weaving frame and comb. For description see page 20.

and begin weaving at the other end, moving forward as the weaving proceeds. The Indian rug weaver cuts full length warp, ties the ends to two heavy poles, and hangs the upper pole in two forked posts. The weight of the lower pole pulls the warp threads taut. She weaves from the bottom upward.

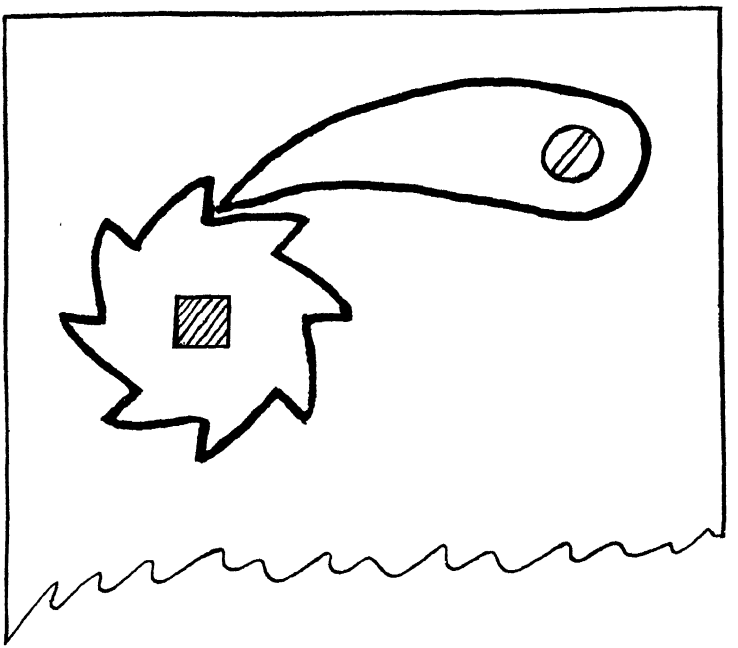


ILLUSTRATION 8. Detail of construction of the ratchet and pawl. The pawl may be made of a strip of steel or brass with a square bend like the letter L loosely screwed to the frame, allowing it to fall into the notches of the ratchet.

Mechanical invention evolved the movable warp beam. (See Illustration 16.) By this means many yards of warp may be wound on the warp beam and tied to the cloth beam at the front of the loom. In this process it is essential that the two beams be set absolutely parallel to each other. Otherwise warp threads will be looser and hence longer on one side and the weaving

will be uneven if not impossible. In the homemade box loom broomsticks may be used in making the beams. The second essential is a method by which the movable beams can be held firm.

An early method consisted of pegs driven into the projecting end of the beam which pressed against another peg inserted in the framework of the loom. The most common present-day plan is the ratchet wheel. This is a wheel with notches cut in its edge. As the wheel turns forward a pointed piece of metal or wood, called a *pawl*, falls into a notch and prevents the wheel from turning backward. This makes it possible to stretch the warp very tight and hold it firm. There are many variations of the principle of the ratchet, a common one being an iron or steel bar shaped like the letter L, the long part being loosely screwed to the frame above the ratchet wheel, allowing the short arm to fall against the notches and prevent the wheel from slipping.

Either of the two methods described above is within the powers of an ingenious boy. (See Illustration page 21.)

These first requisites may be secured in homemade looms, in the form of frames, to be held on the lap, table looms, and footpower floor looms.

Materials Required for a Weaving Frame

2 side pieces—at least ½ inch thick.
—*length*, equal to desired length of frame.
—*width*, about 2 inches.
2 end pieces—at least ¾ inch thick.
—*length*, equal to desired width of frame.
—*width*, at least 1 inch wider than side bars.

Two pieces to strengthen the frame may be nailed underneath the side bars (page 25) or underneath the ends (page 26).

Directions for Making a Small Loom with Movable Beams

Materials needed—a box or rectangular frame; two pieces of broomstick or heavy dowel rod, 2 inches longer than the width of the frame, plus the thickness of the bars; four bars, ¾ inch thick,·3 or 4 inches wide, long enough to extend 3 inches above the top of the box.

1.—Bore a hole through one end of each broomstick, and insert a piece of ¼ or ⅜ inch dowel rod or a heavy nail about 3 inches long.

2.—Bore holes in the upper ends of the four bars, large enough to allow the broomsticks to turn easily in them.

3.—Bore 4 or more small holes ½ inch outside these large holes on two of the bars. A strong nail or peg may be inserted in these small holes to press against the dowel rod in the end of the broomstick to prevent it from slipping backward when the warp is tightened.

4.—Assemble by nailing the bars upright at the corners of the box, as shown in Illustration 7, page 21. Insert one broomstick through the two front bars, the other through the two back bars, preferably with the peg ends at the right.

5.—Nail a piece of tin on the other end of the broomsticks, or in any other convenient way prevent them from slipping out of position.

6.—Before warping, tie a rod to each beam with long cords as shown in Illustration 27, page 54. The cords should be nailed to the beam to prevent slipping when the warp is wound on the beam.

The Ratchet. Instead of the dowel rod suggested above (first step) the ratchet and pawl may be used, as shown on the front beam in Illustration 7 and in the detail drawing on page 22.

Suggestions for Homemade Looms

1. Any box with heavy end boards may be fitted with nails. Preferably the box should be shallow for convenience in handling. Also if the end boards stand higher than the sides, or if the sides are cut away to allow easy access to the warp threads, the weaving will be more comfortably carried on.

2. A frame of any desired size may be easily constructed from scrap material, after the plan of either of the frames on pages 25 and 26.

3. A box loom with movable bars may be built after the style of the one pictured on page 21. To this may be added, in the center, a frame from which harnesses may be suspended as shown on page 32. The harnesses may be operated by treadles or

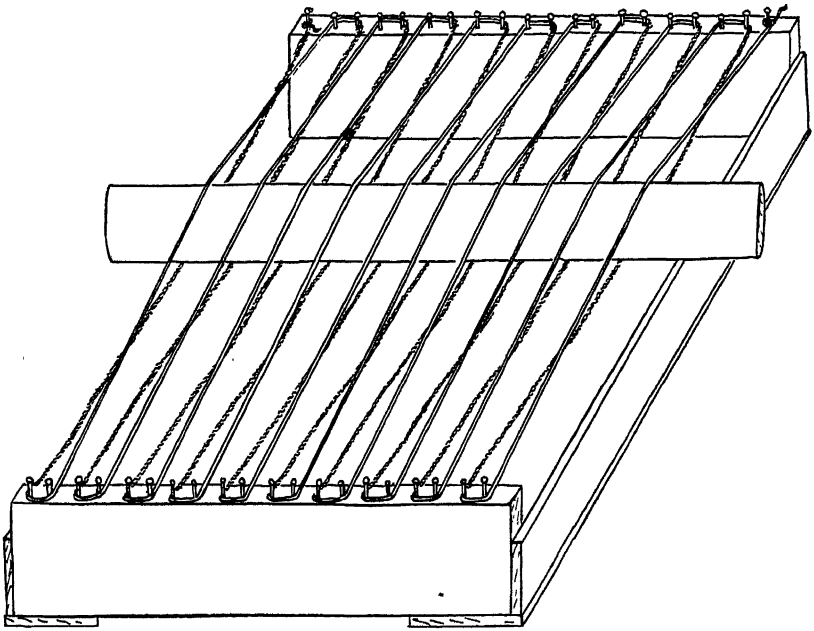


Illustration 9. Shows (a) construction of weaving frame, braced along the sides; (b) warp strung around nails; (c) flat stick inserted between odds and evens to open a shed. See page 27.

by levers as shown on pages 33, 34 and 35. By making the center frame of a wide board, any number of harnesses desired may be used, a lever attachment being provided for each harness.

4. A comb made by driving nails into the edge of a thick stick may be used as a beater. A homemade beater is possible by binding short pieces of stiff wire at each end between two slender sticks and then enclosing this reed in a wooden frame. Since it is difficult to bind the wires very closely together, a commercial reed is preferable whenever possible.

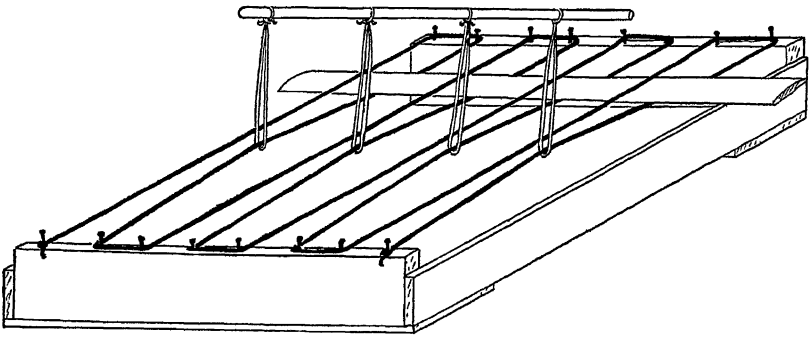


ILLUSTRATION 10. Shows construction of (a) weaving frame braced across the ends; (b) method of lifting warp threads to open a shed by means of long loops tied to a stick as described on page 27-B.

THE EVOLUTION OF THE HARNESS

DARNING even a small hole is so tedious a process that we are prone to avoid it whenever possible. This tedium has stimulated many inventions designed to pick up the warp threads automatically. In the use of the weaving frame shown in Illustration 9, the following procedures may be used. Assuming that the warp threads are strung ready for weaving:

A—Pick up every other warp thread with a broad flat stick such as a ruler. Turn the stick up edgewise thus forming *a shed* through which to thrust the shuttle. This relieves the tedious picking up process in one direction and helps just a little to pick up the under thread when the shuttle is going in the other direction, at which time the stick must be laid flat.

B—To help out in this second direction, a second stick may be used to which a string is tied leaving long loops (see Illustration page 26), each loop being tied around one of the under threads in front of the flat stick, i.e., on the side toward the weaver. With this apparatus the second set of warp threads may be lifted to make a shed for the shuttle to pass through on the reverse shot. This shed will not be as wide as that made by the flat stick.

The Navajo weaver uses a number of such stick and string tools to pick up the threads of her rug pattern.

C—The above experiments led to a third and still more helpful bit of apparatus, frequently called "a heddle." This can be made of tough cardboard, thin metal, or thin sticks tacked to a frame. (See Illustration page 28.) This instrument must be used while stringing up the loom, each warp thread passing alter-

nately through either a hole or the slot between holes. As the frame is raised and lowered a shed is formed alternately lifting and depressing the threads strung through the holes.

This is a great improvement over the methods A and B but has the disadvantage of placing double strain on one set of threads.

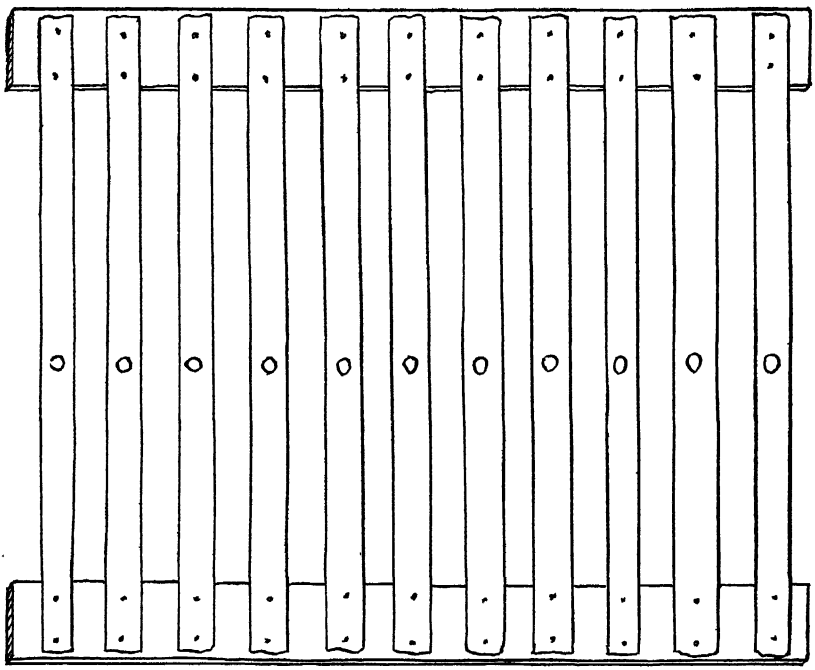


ILLUSTRATION 11. Diagram of wooden heddle described on page 27. See also similar heddle cut from cardboard, in use, on box loom Illustration 7. This heddle may also be made with the top bar extended on both ends and hung from notches in side posts to maintain the shed. See Ill. 15.

D—The next improvement is the heddle frame or harness with string heddles (Illustration 12) which permit closer stringing of the warp. (See Illustration page 30 for method of tying string heddles.) The string heddle is a double cord with knots tied to make an *eye* in the middle. The eyes must, of course, be in

uniform position. Half as many heddles were used as there were warp threads and the frame pushed up and down as in C. The eyes were called shorts and the spaces between heddles called longs. (See Illustration 12.)

A discarded picture frame was used for the basis of the string heddle frame in Illustration 15, page 31. In setting up the loom

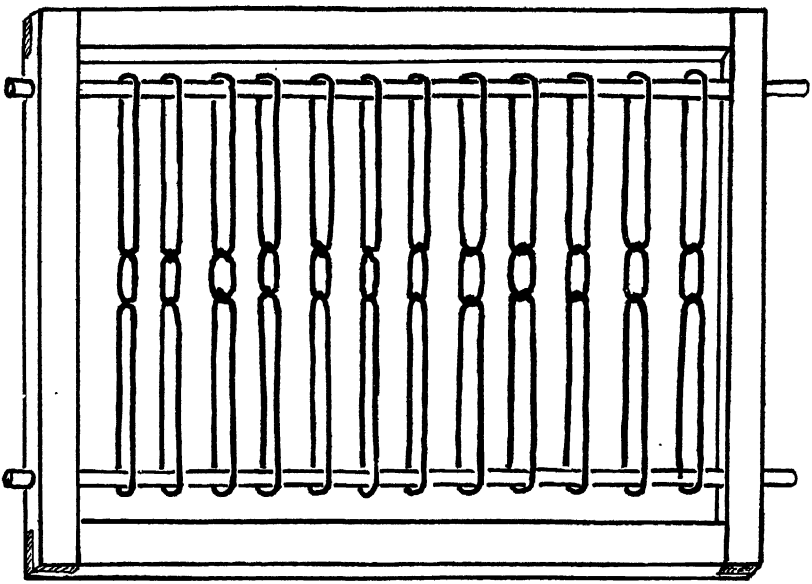


ILLUSTRATION 12. Diagram of string heddles on a frame made from scrap lumber. The round bars are movable and may carry any number of heddles desired. The inside measurement of the frame should be greater than the desired width of the cloth to be woven. String heddles should be six or or eight inches long.

every other warp thread is drawn through a heddle eye. The alternating threads are drawn in between the string heddles. The heddle frame is shifted from the top of the upright bar to the notch in the side of the bar thus forming a new shed. The scarf on this loom is in plain weave. In both warp and woof two black and two white threads alternate, giving a very interesting pattern.

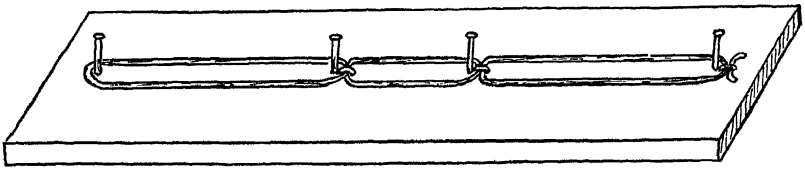


ILLUSTRATION 13. Method of tying string heddles. See pages 28 and 29. Use a fine strong cord for making heddles.

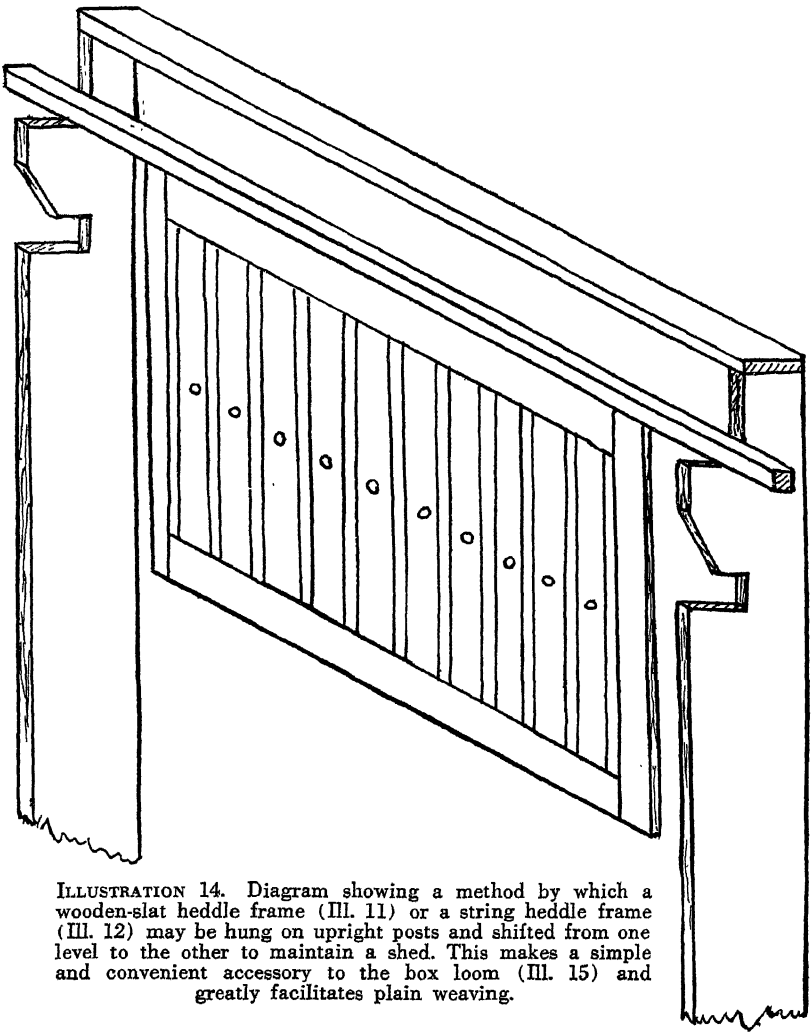


ILLUSTRATION 14. Diagram showing a method by which a wooden-slat heddle frame (Ill. 11) or a string heddle frame (Ill. 12) may be hung on upright posts and shifted from one level to the other to maintain a shed. This makes a simple and convenient accessory to the box loom (Ill. 15) and greatly facilitates plain weaving.

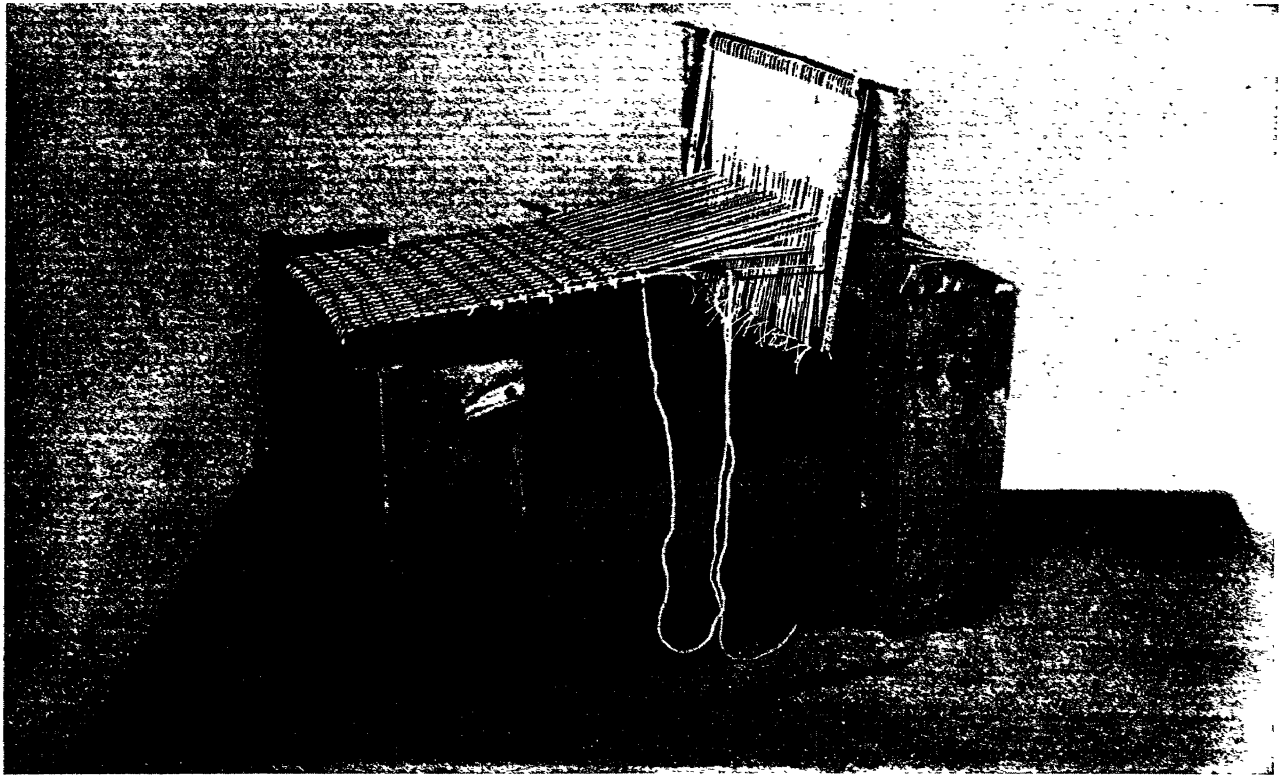


ILLUSTRATION 15. Box loom fitted with string heddle frame. See description page 29.

The Two-Harness Loom

E—The most significant advance is the two-harness loom. This adds a second harness for the other set of warp threads, the odds being threaded through the heddle eyes on one harness, the evens through the heddle eyes on the other. The two har-

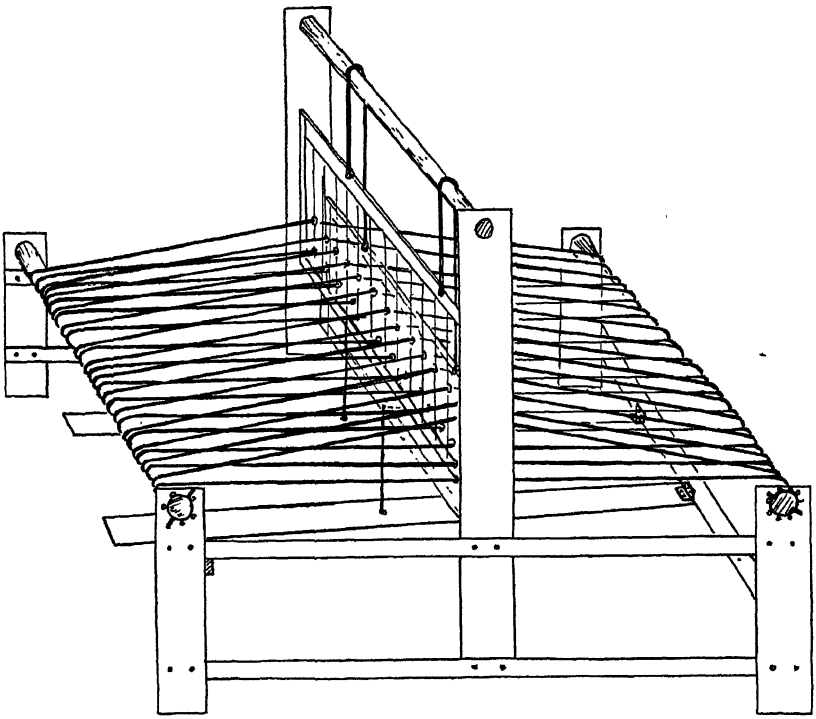


Illustration 16. Diagram showing a two-harness, treadle or foot-power loom with back harness depressed, making a shed between two sets of warp threads. See item *E*, page 32. Treadles may also be used on table looms and operated by hand.

nesses are tied together by two long cords and swung over a pole above the warp allowing the heddle eyes to be on the level of the warp. Other cords tie the lower side of the harnesses to treadles. As the weaver presses his feet alternately on the

treadles, the two sets of threads, odds and evens, are raised and lowered, making the sheds for the shuttle to pass through. It will be noted that now the tension is equalized, instead of one set of threads remaining stationary.

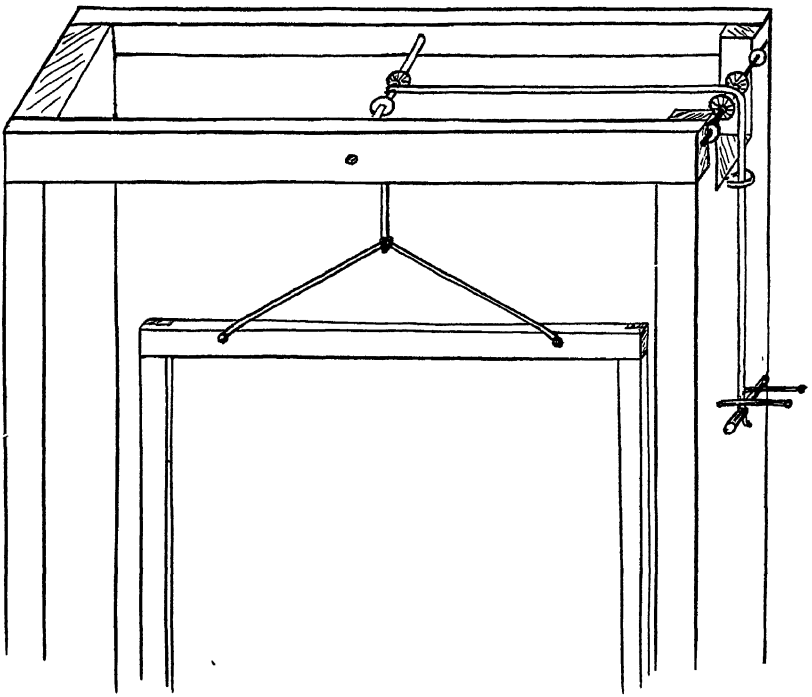


ILLUSTRATION 17. Shows a method of lifting the harness by a cord adjusted over spool pulleys. The right-hand spool operates on a wire fastened across the opening, through two staples. A small stick on the end of the cord, when slipped under the nails, holds the cord in position and raises the harness. A staple just under the opening holds the cord in place over the pulley when the harness is lowered.

This two-harness, treadle combination is the simplest form of foot-power loom. The same effects are secured in modern hand looms operated by levers. The lever lifts the harness whereas the treadle pulls it down. Levers are used on practically all table looms and on some of the newer floor looms.

The diagram on page 32, Illustration 16, shows a two-harness loom operated by treadles. This method of operation may be used on a table loom also.

The box loom shown in Illustration page 21 could easily be fitted with uprights in the center and two harnesses used instead of the card heddle shown.

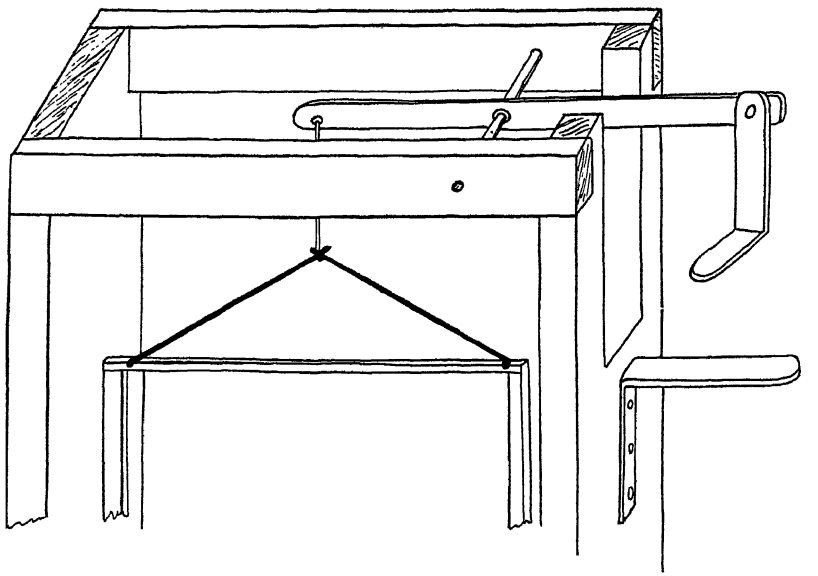


ILLUSTRATION 18. Shows one method of lifting the harness by a lever. A square-bent piece of steel swings loosely on the end of the lever. When this is caught under the arm below, the harness is raised and held in position. The important factor in this method is easy action and a firm hold by the hook. Various modifications of this principle are possible.

Such a harness frame could also be fitted with levers instead of treadles. Three possible methods of operating levers are shown in Illustration 17, 18 and 19.

THE FOUR-HARNESS LOOM

F—The two-harness loom meets the needs of plain weaving but for weaving twill and overshot patterns at least four-har-

nesses are needed. Various methods are used for adjusting the four harnesses. A very common method swings two harnesses

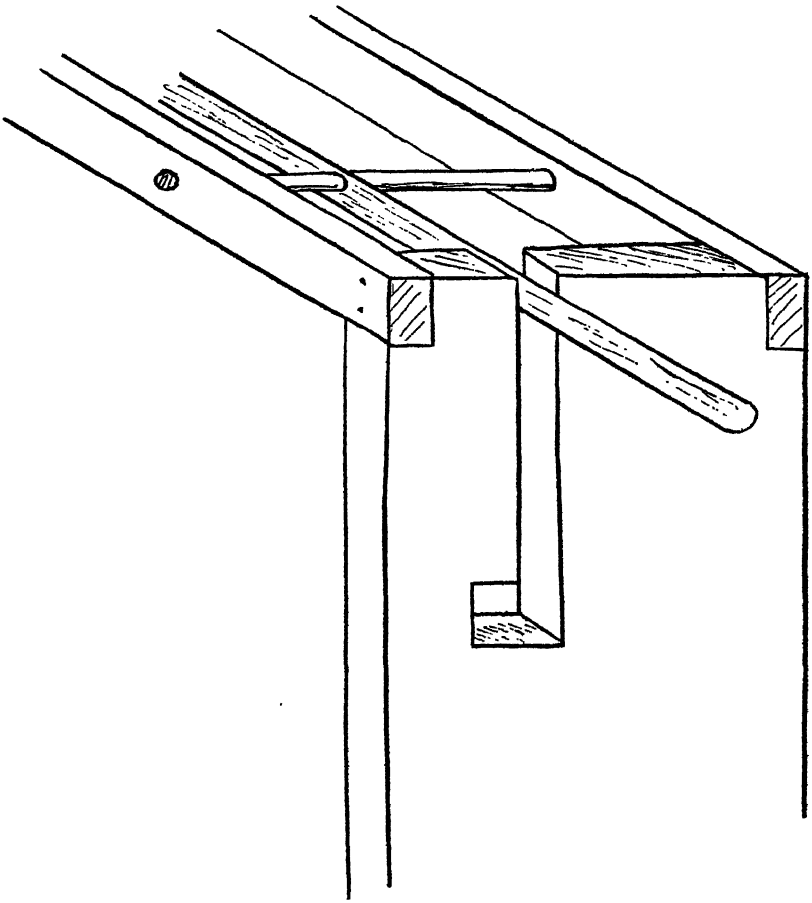


ILLUSTRATION 19. A second method of holding the lever down to keep the harness raised. A lever and slot will be needed for each harness used. When two or more levers are used they must be kept a proper distance apart by placing between them, on the cross-bar, washers or sections of spools. Otherwise the harnesses may interfere with each other when shifted.

over pulleys attached to another cord swung over the pole as in the two-harness loom. A treadle is fastened to each harness.

In the old colonial looms bars called *lambs* were attached

between the harnesses and treadles for the purpose of equalizing the tension and facilitating combinations by a process called the *tie-up*. In modern looms operated by levers, the harness is lifted for use and falls back into place by its own weight when released. The combinations are easily made in the use of the levers and the tie-up is unnecessary.

In the four-harness loom the most common procedure is to string all the *odd* threads (1, 3, 5, 7,) in, say, the odd harnesses (No. 1 or No. 3) and all even threads (2, 4, 6, 8,) in, say, the even harnesses (No. 2 or No. 4), or vice versa. By operating 1 and 3 together *against* 2 and 4 a plain weave is secured. The warp threads are strung according to a pattern. The harnesses may be operated singly or in various combinations allowing unlimited variation in the patterns resulting. In this opportunity for creative activity lies the fascination for the weaving process.

Descriptive Note Concerning Frontispiece and Illustration 20

Fig. A represents warp and woof of same material, loosely woven to show process.

Fig. B shows wide-spaced fine warp, woven with heavy woof. The dark woof is pressed down to cover the warp completely. Navajo rugs are woven in this way.

Fig. C shows the effect when warp is set close, almost hiding the woof. This also shows the warp strung through staggered holes. The use of the card does not permit very close stringing of the warp. The threads are pushed together to show possible effects.

Fig. D shows variation in both warp and woof using fine and coarse threads in combination in the warp and repeating the combination in the woof. An infinite variety of such combinations is possible.

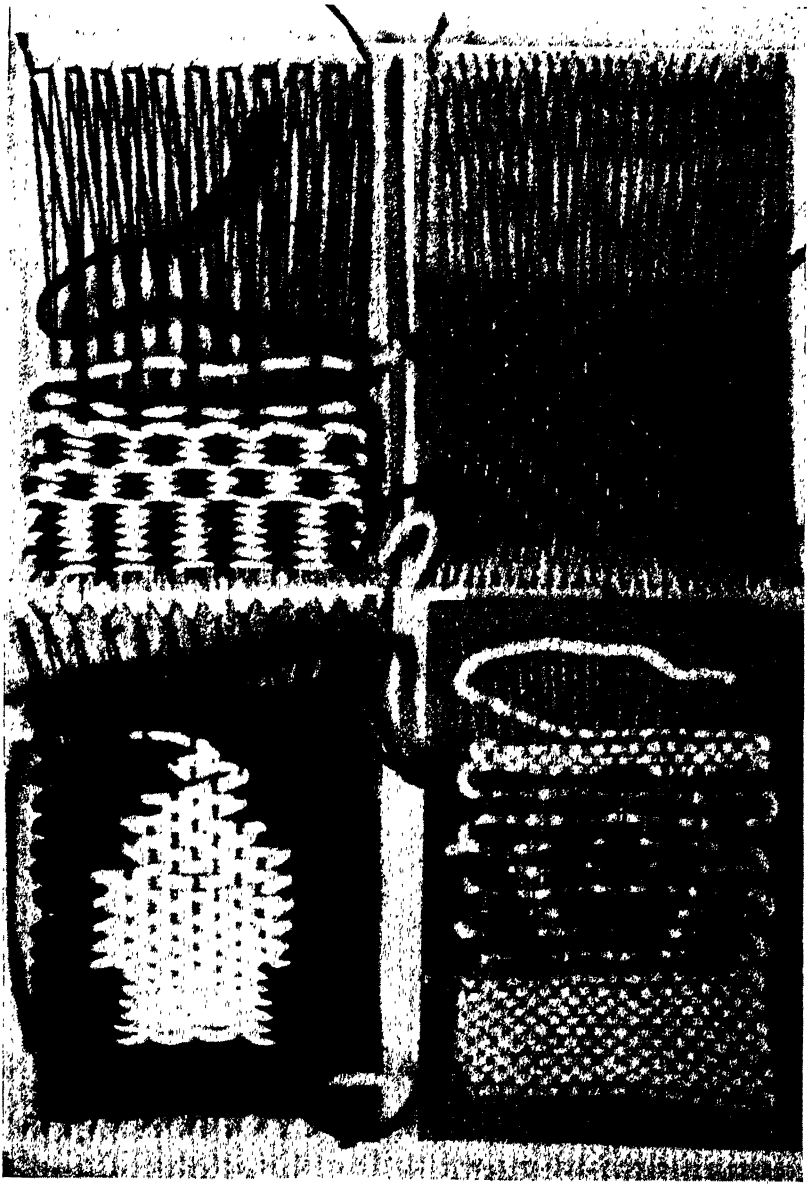


ILLUSTRATION 20. Sample weaves done on cards. See page 38.

Vertical stripes and checks. (E)
Spot, loosely set to show process. (F)
Twill weave. (G)
Overshot pattern (H)

Fig. E, using fine warp and a coarser woof, two contrasting colors are used alternately, thus producing stripes lengthwise of the material. The stripes are reversed to make checks by carrying one color thread back the second time (in this sample the light color) thus reversing the position of the two colors. Note also the interlocking of the two colors on the edge.

Fig. F shows a light spot set in a dark background by the use of three threads, two of the background color, one for the spot. Each thread is woven back and forth in its space, the two colors alternately making a turn around the warp thread which forms the outline of the spot. The shape of the spot is controlled by changing from one to another warp thread as the outline.

The lower part of the sample shows the effect when the woof threads are pressed closely together. The upper part is left open to show the process.

Fig. G shows a sample of the *twill* weave in which the woof goes under one and over three warp threads. On each shot the *one* thread picked up moves one thread to the right or left in regular order thus producing the diagonal lines shown.

Fig. H shows a sample of the *overshot* weave in which skips similar to those in the twill are made irregularly but following a definite pattern. Two woof threads are used. In the sample the heavy dark thread makes the pattern. The light thread is the binder or tabby thread which makes the background. The binder thread follows the plain weave regularly, while the pattern thread is woven in between shots of the binder threads.

WEAVING ON CARDBOARD

FOR children's first work small pieces of stiff cardboard are often used. On these string or yarn is used for warp. The warp may be (*a*) wound around notches cut in the ends of the piece of cardboard or (*b*) passed through holes punched near the ends of the cardboard. The warp sometimes slips off from notches. This difficulty is avoided by the use of the holes. As the holes cannot be punched very close together without weakening the cardboard this plan is suited only to coarse weaving over warp threads relatively far apart. This difficulty may be partially overcome by staggering the holes, that is, punching them alternately on two lines as shown in the sample illustrated on page 37.

Procedure may be varied in several ways:

A—By stringing the warp around the notches, the weaving is kept on one side of the cardboard. This weaving will produce small flat pieces suitable for rugs on a small playhouse.

B—By stringing the warp around the bottom edge of the card and around the notches at the top of the card, the warp will be on both sides of the card. It is then possible to weave both sides, carrying the weaving thread around the ends of the cardboard. This process will make a small pocket or hand bag, closed at bottom and ends of the cardboard and open at the top or notched edge.

C—Circular cards may be used, stringing the warp across the center of the card, back and forth through holes or around notches in edge of the cardboard. The weaving proceeds round and round from center to circumference. Left flat, the result

is a mat. Drawn in at the edge, it becomes a cap for doll or child, according to the size.

These procedures have sometimes been carried to extremes in providing cards cut in many shapes or patterns for the weaving of doll coats, sweaters, and other garments. These patterns have frequently been evolved in the adult imagination, stimulated often by the desire to have something to sell. They are seldom built upon children's experiences and interests.

Weaving on cardboards permits only the pick-up process of darning and has all of its tedium. Children who are permitted no other form of activity will welcome even this as a release from the greater tedium of unbroken book work. There are, however, so many more valuable forms of activity possible for school use that the author does not commend these procedures for extensive school use. A little energy will make possible the use of box frames and looms and greatly increase the educative possibilities and at the same time eliminate many undesirable features of weaving on small cards.

Weaving on cardboards not only has all the tedium of darning, but being done on small cards it must be undertaken with relatively fine yarns, making the work intricate for small fingers and hard on young eyes.

The *adult beginner* will find it interesting and illuminating to test out on small cardboards, as illustrated on page 37, the variations of any desired weave. These samples need be only a few inches on each dimension to show what happens under different circumstances.

This procedure is recommended for *adults* only. Children's work should grow out of their daily needs and experiences. They should weave for purposes useful to them and not for technical study.

WARP

What to use. The needs are so varied that almost any strong thread or cord may serve the purpose at some time. The first requisite is that it be strong enough to bear the strain which must be put upon it when stretched upon the loom.

For first work on a weaving frame common wrapping twine serves well. Carpet warp, available in many colors, is similar to twine, but generally not so tightly twisted.

Commercial houses handling weaving materials will furnish samples and price lists which include the number of yards to the pound of the various warps. These include cotton, linen, wool, silk, rayon, etc., in all gradations from very fine to very coarse, and a wide range of colors.

Warps are sold in skeins and on spools and tubes in varied quantities. In a few cases warp is available ready wound on spools which fit certain looms. These are great time savers when the supply meets one's particular need.

To estimate the warp needed for a particular job:

1. Count the threads to be used in one inch;
2. Multiply this number by the width in inches to find total number of threads;
3. Multiply the desired length by the total number of threads.

In estimating the length, add to the actual finished length of the article planned, enough to allow for tying the warp to the beams. This item will vary according to the size of the loom and the material to be used. The distance between the two beams will give the basis for this measurement. A very coarse woof will take up more warp than fine thread. Also certain warp

threads are more elastic than others and their length will be greater when stretched taut on the loom than when released. It is necessary to allow for all of these items in estimating length of warp.

As a concrete example: for a scarf 9 inches wide, with 15 warp threads to the inch, 9 x 15 or 135 threads will be required. Decide upon the length desired for the finished scarf, allowing for a hem or for fringe as preferred. To this total add what will

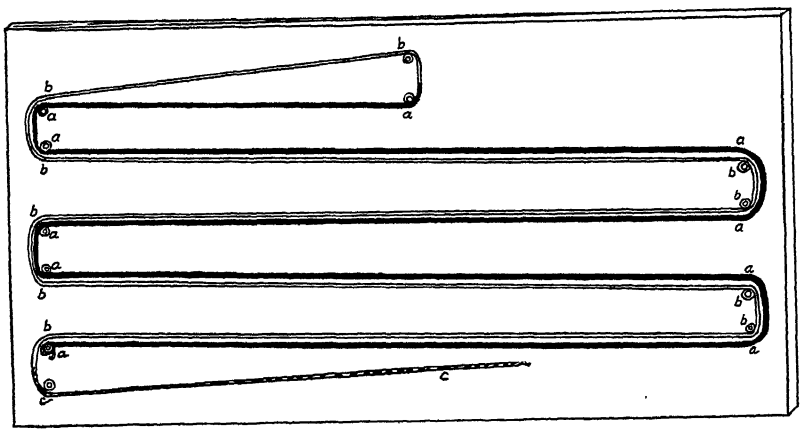


ILLUSTRATION 21. Shows a method of measuring warp. Nails are set where necessary to measure the length desired. Warp is wrapped back and forth around nails. Follow course of *a*, which returning is *b* the second length, and becomes *c* the third length after it passes the starting point. Cut loop ends, remove, and wind or crochet to prevent tangling. See page 43.

be required for tying the warp to the beams. If fringe is to be used it may be counted in the tie-up allowance. Until the weaver has learned from several experiences what to expect, it will be well to test the warp to be used and observe carefully how much is needed in order to find the happy medium between allowing too much, thus wasting precious material, and the other extreme, which is even worse, of finding the finished article too short for its purpose. Part of the fun of weaving comes through meeting and mastering these interesting variations.

Measuring warp length. The simplest homemade apparatus

is a broad board into which nails may be driven at each end around which the warp may be wound back and forth. (See Illustration 21.) Set the nails to measure the article planned for. In winding the yarn around the nails for measurement it is very important to observe tension. Avoid drawing the warp too tight. Some yarns, especially wool, are very elastic and if drawn too tightly on the measuring board may prove several inches shorter than planned when removed from the board. It will be found also that some tightly twisted yarns tend to twist back on themselves. This must be watched to prevent the formation of knots. When a definite number of lengths has been measured (as 10) cut the loop at each end and take the warp from the board. It should then be crocheted into a chain, or wound on a stick or into a ball to keep the threads in order and prevent tangling. If two or more colors are to be used, the number of lengths of each color in each stripe should be measured and wound off separately for convenience in threading into the harnesses.

The Illustration 22 on page 44 shows a homemade apparatus for measuring warp. The wheel measures a yard at each revolution. On one bar of the wheel is fastened a strip of heavy cloth in which eyelets are set closely together. The end of the thread to be measured is tied in an eyelet. A number of threads can be measured at once if desired. When the thread has been measured, ends are drawn down and passed over and under several rollers to regulate the tension and through a comb set upright on the cross bar to keep the threads straight as they are wound on the bobbins or, as in the picture, directly on the warp beam of the loom which was being set up for several scarfs.

This apparatus was constructed from scrap lumber. The combs were made by driving small nails into the edge of a ¾ inch board. A Structo Hexagonal warp beam was inserted for use in winding the spools used with this warp beam.

ILLUSTRATION 22. Homemade reel for measuring warp described on page 43.

SETTING UP A WEAVING FRAME

ASSUMING a frame similar to that shown in Illustration 9 with nails in each end set ¼ inch apart, the first problem is to string it with warp. The warp may be ordinary wrapping twine, carpet warp, or wool yarn as preferred, a cotton warp being better for first attempts. The warp thread is carried back and forth from end to end around *two nails at each turn.* The warp should be drawn snugly but not stretched to the full extent as allowance must be made for the weaving which takes up space and increases the tension.

To prevent the tendency to *draw in* at the edges as the weaving progresses, it is desirable to lay in, with the outside threads, a heavy wire or steel rod. A rod ⅛ inch in diameter gives best service. If such a rod is not available the outer warp threads should be doubled and stretched quite tight. If a variation in color is desired in the warp it must be planned for in the set-up.

To weave on a weaving frame, a long wooden or steel needle serves as the shuttle. With the end of the frame toward the weaver, and beginning at the right, every other thread is picked up with the needle, i.e., 1, 3, 5, 7, 9, etc. The needle should be threaded with rags, candlewick, rovings, or any heavy yarn desired. For first work with children it should be quite coarse in order to fill in rapidly and give the weaver a sense of accomplishment. After the first woof thread is pressed into place, the needle is entered from the left and the alternate threads (2, 4, 6, 8, etc.) are picked up and the woof drawn through. Care should be taken to secure a good turn at the edge; tight enough not to leave a loop; loose enough not to pull in the warp thread.

If the steel bar, mentioned above, is used, the woof thread goes around both warp thread and bar together. This provides for a firm edge after the bar is drawn out.

The Comb. To press the woof threads firmly into place, it is desirable to have a comb made by driving nails ¼ inch apart into the edge of a stick approximately ½ inch thick by ¾ inch

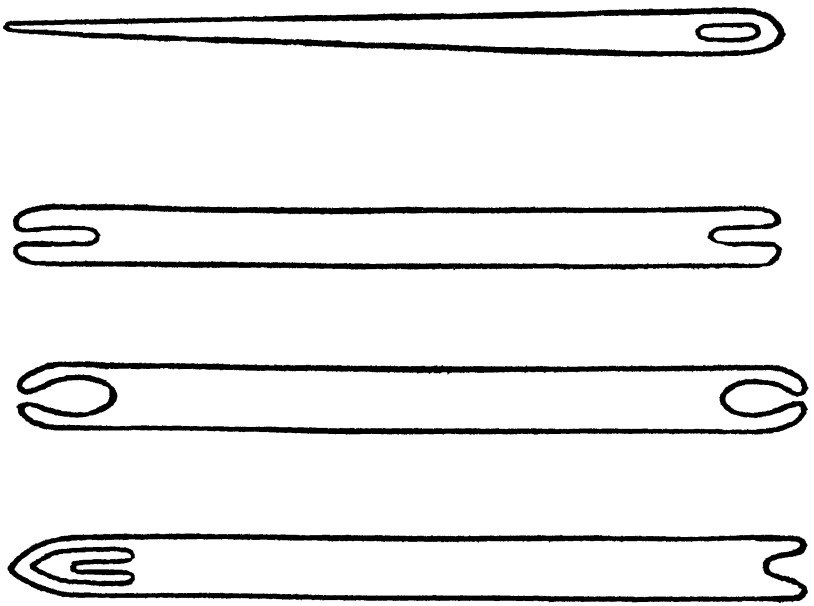


ILLUSTRATION 23. Types of shuttles. The upper figure is a weaving needle for use on weaving frame. If these are made by hand, hard wood should be used and carefully sandpapered to avoid any roughness.

wide and as long as the width of the frame. The use of the comb helps to keep the weaving even on the edges. The weaver should bear in mind that the woof thread must go up and down against the warp and must not be pulled tight. A little thoughtful practice will show the best tension. The procedure outlined above, if the woof is pressed closely, should cover the warp entirely and produce a firm thick web.

Color stripes may be introduced by using a different colored thread as weft. The width and combination of such bands of color is limited only by the weaver's initiative; practice will suggest new designs.

Checks and stripes which run lengthwise of the weaving may be produced by alternating two woof threads of contrasting color. In this process the weaver must use care to have the two threads interlock on the edges to keep a firm selvedge. To make checks, carry one color across twice, thus shifting the color to the other set of warp threads and proceed as before to use the colors alternately. (See Illustration 20.)

Spots of various shapes may be woven in by carrying three threads—one for color spot and two for the background. The three threads are carried along together, each being woven back and forth in turn, the background threads filling out the spaces on either side of the spot. (See Illustration 20.)

Opening the shed. As the process of picking up the warp threads becomes somewhat tedious especially if fine or close set warp is used, time and energy may be saved by running a thin flat stick or school ruler through, separating the odd and even warp threads. It is then possible to open a shed by turning the stick on edge and thrusting the needle all the way across in one motion. This will be found very convenient on the back stroke or left to right direction. (See Illustration 9.) The use of this bar to open the shed will at once create a desire for a means of raising the second set of threads. This may be accomplished by tying each of these threads to a stick by means of a loop long enough to permit the opening of the first shed by the flat stick. (See Illustration 10.) The second shed will not be as wide as the first but will help noticeably.

SETTING UP A TWO-HARNESS LOOM

LET us assume that we are preparing for a plain weave, 30 threads to the inch, through a 15 dent reed, on a two harness loom.

1. The warp threads must be measured and cut. (See Illustration 21, page 42.) Each group of threads, probably 10, should be crocheted into a chain, wound on a stick or into a ball.

2. The direction of the threading will be from front to back. The *ends*, as the weaver calls his warp threads, are then in position to be tied to the *warp beam* ready for winding when all the warp has been threaded through both dents and heddles.

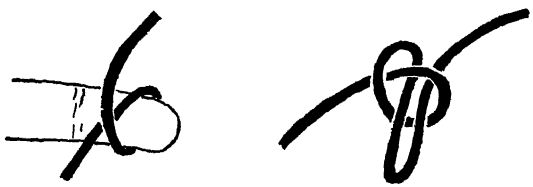


ILLUSTRATION 24. Shows method of making slip knot.

3. The first two warp threads are drawn through the first *dent* of the reed, with the drawing-in hook.

4. One of the two is threaded through the first heddle on the front harness. The other is threaded in similar way through the first heddle on the back harness.

5. When the first group of 6 to 10 threads has been threaded through the harnesses, the ends should be drawn evenly together and tied in a slip knot (see above) to avoid tangling before tying to the warp beam.

6. Continue this process until all warp threads have been threaded into the heddles.

Some Variations and Notes on the Procedure Outlined in 1-6

a. If the weaving planned is to be narrower than the full space of the reed, adjust the threading to balance the space used in the center of the reed, leaving relatively equal margins of unused dents on either side. This will help to keep the warp threads straight and the tension uniform while weaving is in progress.

b. In order to have a firm edge on the woven cloth, it is generally desirable to plan for a selvedge by threading the first and last 6 or 8 threads closer together, i.e., four instead of two threads to the dent.

c. Warp thread which is tightly twisted is likely to twist back on itself and vigilance is necessary to prevent knots.

d. Wool warp because of the nature of the fiber is more likely to rough up a fuzz and make the threads cling to each other. Vigilance is needed to avoid knots from this cause.

7. *Tying the warp to the warp beam.* The warp beam must be supplied with an apron (Illustration 25, page 50) or a rod (Illustration 26) tied firmly to the beam. A small bunch of warp threads equaling not more than the threads which occupy an inch of space in the reed is

—passed under this rod
—divided into two parts
—one half drawn over the rod and around under the bunch from the left
—the other half around and under the bunch from the right
—making the two parts cross underneath
—and tied with a slip knot on top. (Illustration 24, page 48.)

Note—This slip knot allows for easy retying of the knot if any thread is found to be too loose or too tight.

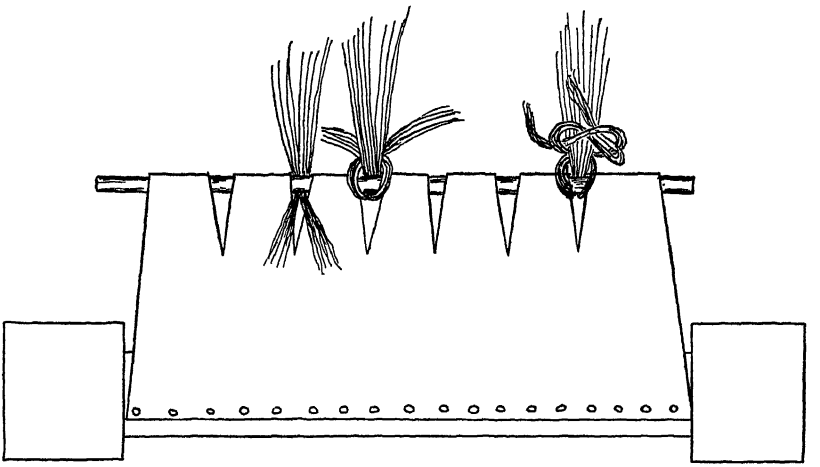


ILLUSTRATION 25. Shows "apron" attached to warp beam and steps in process of tying warp. The apron is a double piece of muslin with edges tacked to the beam. A dowel rod or stiff wire is slipped within the folded edge to keep the edge straight. See page 49.

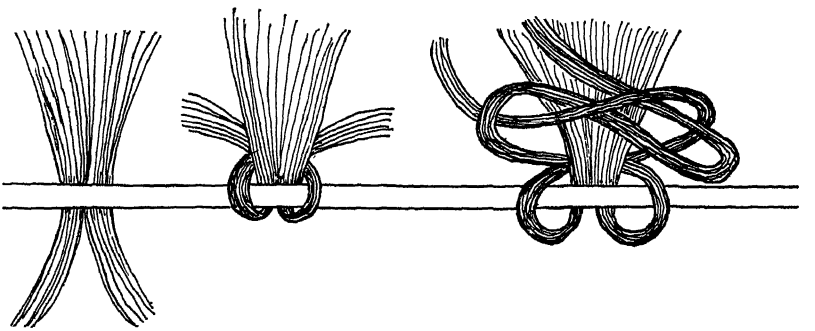


ILLUSTRATION 26. Shows three steps in tying warp to rod attached to warp beam. See page 49.

8. Continue until all threads are tied to the warp beam.

9. Distribute heddles and ties to insure even spacing of threads.

10. While one person, standing in front of the loom holds the warp firmly another carefully turns the warp beam winding the warp as evenly and firmly as possible around the beam.

Note—This is a very important step in the procedure. If some threads are loose and others tight, smooth and even weaving is impossible. If the warp threads are allowed to pile up on one part of the beam leaving valleys on either side, smooth weaving will be impossible because the thread going around the high part will be longer than the thread going around the low part. This will make some threads loose and others tight as weaving proceeds. Strive for an evenly wound warp beam, with all threads regularly spaced and of equal tension. To avoid this tendency to uneven winding it is helpful to insert, at intervals, a thin flat stick or rod which will restore the level of the winding. It is particularly important to watch this tendency to unevenness at the ends of the beam as it is easier there for the warp to slip down into a shorter circumference.

11. When all the warp has been wound on the warp beam except enough to tie to the cloth-beam at the front of the loom, repeat the method described above (par. 7) and illustrated on page 50. Adjust and readjust as often as necessary to make sure of even tension on all threads.

12. The weaving process may now begin. See directions which follow.

Variations on the Foregoing Directions—Ready-Wound Warp

Some looms are supplied with the warp beam already wound with warp. In this case the measuring is omitted and the direction of the threads is from back to front. Warp thread No. 1 will be threaded through heddle No. 1 on the back harness, thread No. 2 through heddle No. 1 on the front harness, and both threads drawn through the first dent in the reed. The process is the same as outlined in items 2 to 5 except in reverse order and direction.

Certain supply houses sell small spools containing 60 ends which are used similarly to the ready-warped beam. In using ready-prepared warp, it is necessary to unwind the warp a sufficient number of turns to have warp long enough to reach to the front beam. It is very important and especially with the small spools, to unwind the warp of each spool the same number of turns, otherwise the circumference of the spools will vary, and one turn of the warp beam will

release more warp from one spool than from another making it impossible to keep the warp threads at an even tension.[1]

The loom shown in Illustration 27 was planned for and is now in use in the Crippled Children's Ward, Noyes Hospital, University of Missouri. Observe: (*a*) The heddle frame swings from the upper roller and is held in place by a ball and cord fastening. (*b*) The warp is tied to a rod which is tied to the warp beam. (*c*) The first weaving on newly tied warp is done with extra heavy weft until warp threads are separated and evenly spaced.

[1] The Structo Hexagonal Warp Beam and the spooled warp to be used with it, are sold by the manufacturers, The Structo Manufacturing Company, Freeport, Illinois.

WEAVING ON A TWO-HARNESS LOOM

1. The woof or filling must be wound on the shuttle.

2. One harness is raised by pressing down one lever, or treadle, thus forming a shed between the odd and even threads. (See Illustration 16, page 32.)

3. Thrust the shuttle through the shed toward the left and draw the woof thread through, leaving a few inches hanging at the end.

4. Throw forward the beater pressing the woof thread into place.

5. Release the lever and press down the other one thus bringing up the second harness.

6. Use the beater again to press the woof more firmly into place and to readjust the warp into the new shed.

7. Throw the shuttle through the shed toward the right.

8. Notice the turn made by the woof thread on the left edge. It must not be drawn too tight and *pull in* nor must it be too loose and leave a loop. Adjust this turn at the edge and let the thread lie loosely enough in the shed to allow it to go up and down over the taut warp as the beater pounds it into place. A firm even edge is one mark of good weaving. (Illustration 28.)

Note—When a loom is first set up with new warp the threads will be grouped in bunches as they are tied to the cloth beam. In order quickly to draw together the spaces between the bunches, it is desirable to use a very coarse woof to weave the first few inches. Each throw of the beater will hold the warp threads a little more firmly in place and make a firm background against which to weave an even web. (See Illustration 27.)

The use of the beater. The amount of pressure to be exerted on the beater will depend on the type and purpose of the cloth being woven. In most cases a square mesh is desired.

For a filmy scarf of silk or wool an open mesh is desired,

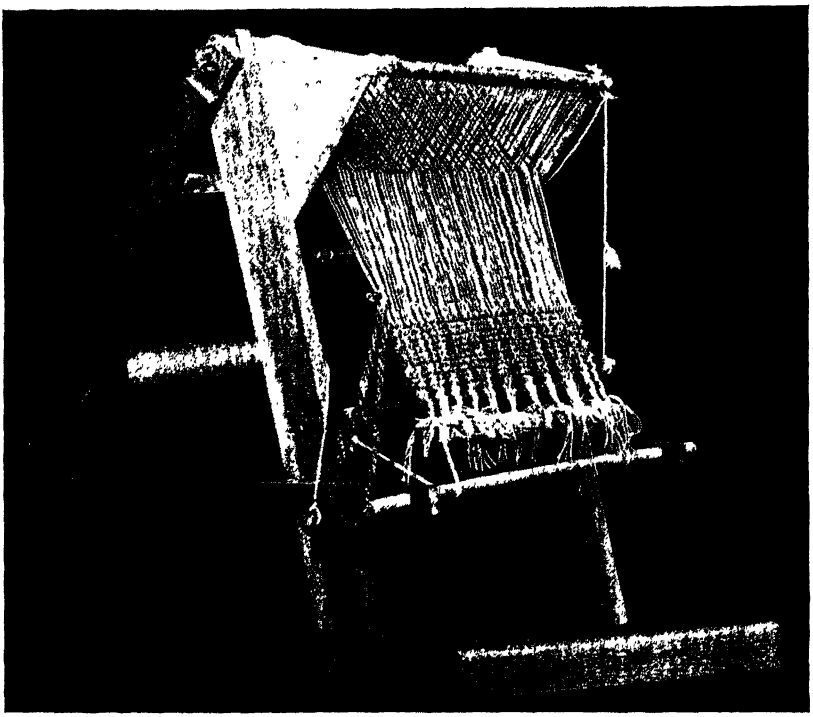


ILLUSTRATION 27. Homemade easel loom with vertical warp. For description see page 52.

in which case the warp threads will be set farther apart and the woof will be lightly beaten to keep the open square mesh. For a closely woven linen towel or lunch cloth, a close weave may be desired, in which case the woof will be beaten into the close set warp, again making a square mesh but so close that no open space is left.

Caution—In the desire to secure close weaving the beginner often pulls on the woof thread and thus causes the strip to become narrower. A close weave is secured by beating each woof thread close against the one preceding—not by pulling the woof thread.

The strip of cloth should at all times be as wide as the space covered by the warp as it comes through the reed. If allowed to draw in, the beating process will rub too hard against the outer threads on each side and cause them to break. This is a common fault with beginners.

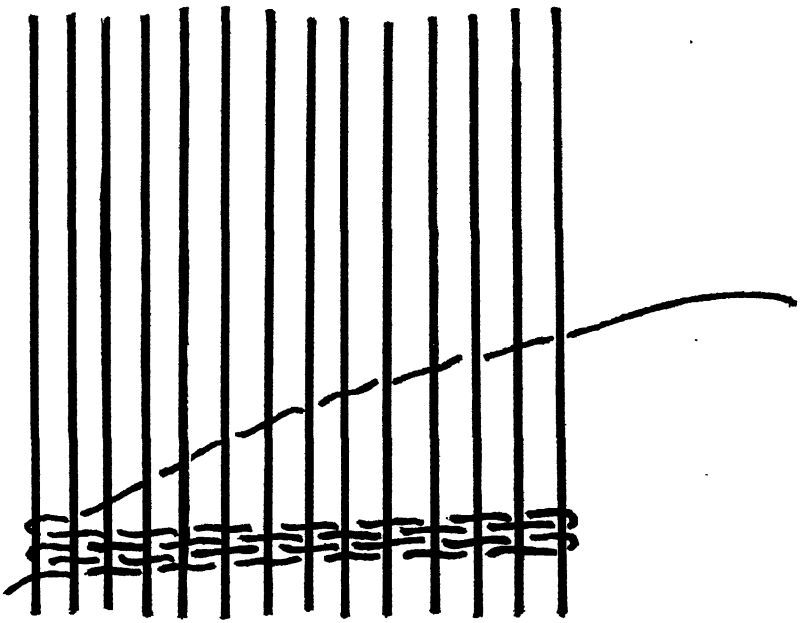


ILLUSTRATION 28. A woof thread slanting loosely across the warp within the shed before the beater is used. Attention is given to the margin to insure a firm straight edge. See page 53.

Practice on the *plain weave* without any variations should continue until the weaver is able to produce a cloth of even texture and good edges.

Variations of the plain weave on a two-harness loom. Color bands across the web are the simplest variation as it only means using a different shuttle wound with a color. The width

of color bands and combinations of color offer unlimited scope for the inventive genius of the weaver.

Bands of a different material may also be used, a heavier material being quite effective. By using two woof threads of contrasting color alternately, one color will come over the *evens* and the other color will come over the *odds*, every shot, thus producing stripes lengthwise of the weaving. In using this weave it is essential to interlock one color around the other on each edge to make a firm finish. (See Illustration 20, page 37.)

This process may be used to produce checks alternating the colors. To do this, when the color spot is square or the size desired, reverse the colors by weaving twice with one color. Do this once only and alternate the colors as before. This throws the color that came over *the evens*, to a new position over *the odds*.

The width of these stripes and checks can be modified by picking up two or more instead of one warp thread. For this process the harnesses cannot be used. However a system of loops tied to a stick can be made to pick any threads desired. These loops should be tied between the harness and the beater. (See Illustration 29, page 57.)

The above variations in the plain weave are all made with the woof only. Still further modifications in color and texture may be made by using different colors or different weights in the warp.

These variations in the warp will produce lengthwise stripes when a single color is used for woof.

Checks and cross bars may be made by repeating with the woof the variations made in the warp, or as the weaver expresses it, "weave as drawn in."

Splicing. In the use of colors and when adding a new woof thread it is important to *splice* neatly. This may be done in several ways.

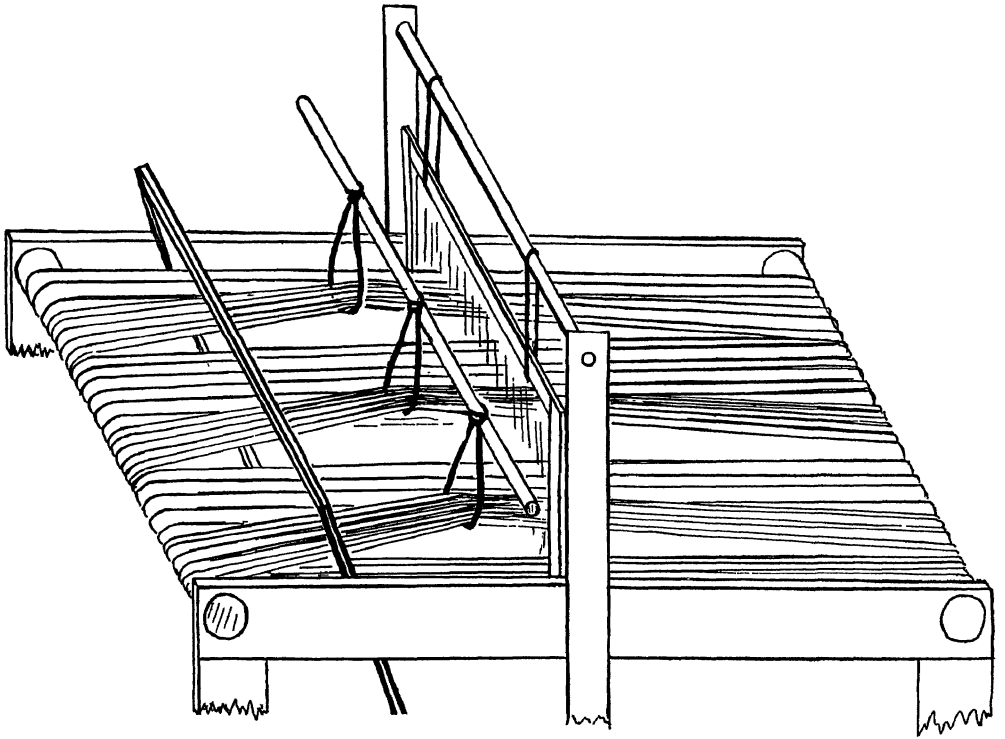


ILLUSTRATION 29. Shows method of tying loops around a number of warp threads to weave a color pattern in addition to a plain weave on a two-harness loom. See page 56.

a. When adding a new color line, it is desirable to keep the color line distinct. This may be done by turning the end of the thread around one or two warp threads at the edge of the weaving and letting it rest against itself. When this is beaten into place the extra width is scarcely noticeable.

b. When a splice of a solid color occurs in the body of the weaving the two ends may overlap for not over two inches, and when closely beaten will scarcely show, especially if the ends have been frayed.

c. When narrow stripes of color are used, the color thread need not be cut, but carried along the selvedge, either woven in with the outer warp thread or carried outside if the space is short. Examine the edge of plaid gingham for an example of this procedure.

d. In some instances, as in the case of an open mesh scarf, none of the above will serve as any lapping of the woof would show plainly. In such a case leave an end hanging at the selvedge and, after the scarf is off the loom, overcast the end into the selvedge edge. As this applies chiefly to very sheer materials the overcast is not conspicuous.

e. Avoid knots as far as possible, but if a warp thread breaks, it must be spliced and two knots are inevitable.

The square knot gives a strong flat connection.

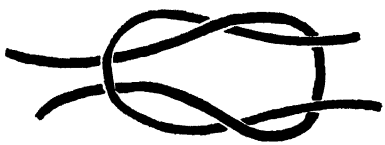


ILLUSTRATION 30. Shows method of tying a square knot. The second turn of the threads simply reverses the direction of the first turn.

SETTING UP A FOUR-HARNESS LOOM

THE same factors of measuring warp and winding it on the warp beam, already described for the two-harness loom, enter into the setting up of the four-harness loom. (See page 45.) Assuming that the warp is ready on the warp beam the new procedure is the threading of the harness.

THREADING FOR A PLAIN TWILL

This procedure is very similar to the threading for the plain weave. The first thread is drawn through heddle No. 1 on the first harness:

—the second thread through heddle No. 1 on the second harness
—the third thread through heddle No. 1 on the third harness
—the fourth thread through heddle No. 1 on the fourth harness
—the fifth thread through heddle No. 2 on the first harness
—the sixth thread through heddle No. 2 on the second harness
—the seventh thread through heddle No. 2 on the third harness
—the eighth thread through heddle No. 2 on the fourth harness—

and so on until the threading is completed, threads, heddles, and harnesses being taken in regular order.

Weaving with this set-up will produce diagonal lines in the texture of the cloth, the harnesses being lifted in regular order, 1, 2, 3, 4, 1, 2, 3, 4, etc. The plain twill in the form of a pattern would be written as in Illustration 31. Each horizontal line represents a harness. Each filled square indicates a warp thread. Assuming the weaver seated in front of the loom, the lower line represents the front or nearest harness. Numbering is from right to left. This is the customary and accepted order. However it would not affect the pattern if the positions were reversed. Regular order is essential.

Caution—On some looms the harness frame is open only at one end for the removal of heddles. In such a case it is important to begin at the closed end to allow adjustment in case any harness runs short of heddles before the threading is completed.

Variations on the twill weave. Reversing the direction of the diagonal line at regular intervals, adds interest to the twill weave. This may be produced by lifting the harnesses in reverse order—4, 3, 2, 1. The twill may be further varied by reversing the direction in the threading process. The written pattern would then appear as in the Illustration on page 61.

The above twill pattern may be set up in various ways.

1—1, 2, 3, 4, repeated until all threads are set.

2—1, 2, 3, 4, alternated with 4, 3, 2, 1, as shown. This may be set in any desired number of repeats one or more in each direction.

3—The following combination gives interesting variety. The number outside each parenthesis indicates the number of repetitions of the harness numbers within the parenthesis:

a . . . . . 2(1,2,3,4,) or 8 threads
b . . . . . 1(3,2,1,2,3,4,3,2,1,2,3,4) or 12 threads

c . . . . .1(3,2,1,) or 3 threads
d . . . . . .3(4,3,2,1,) or 12 threads
e . . . . .1(2,3,4,) or 3 threads, that is, *a* to *f*
f . . . . . .3(1,2,3,4,) or 12 (total 50) threads
g . . . . .Repeat lines *b, c, d, e, f* 3 times or 3 x 42 or 126
h . . . . . Repeat line *a* or 8

a—selvedge	8
b—f 42 x 4 or	168
a—selvedge	8
	184

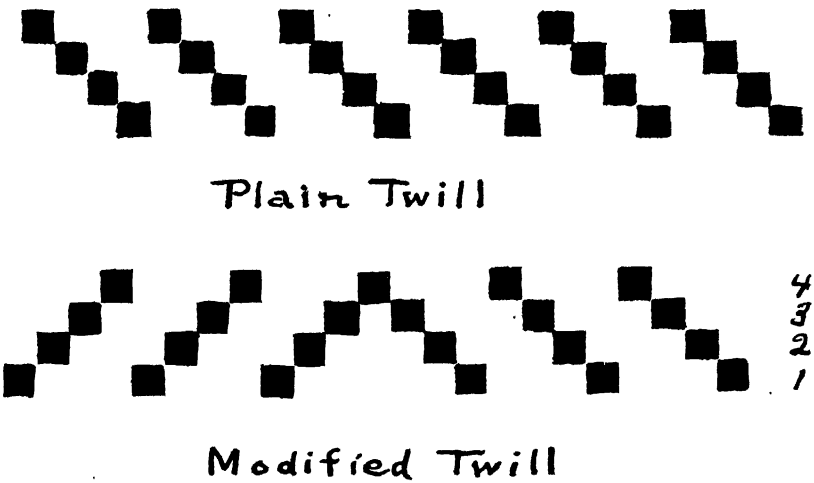
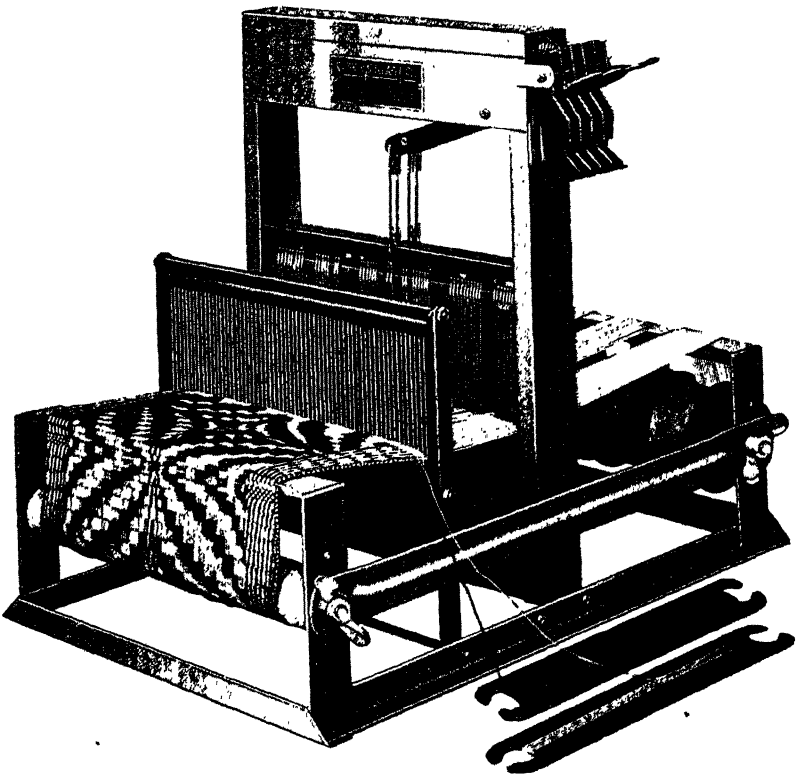


ILLUSTRATION 31. Patterns for plain and modified twill weave.

This set-up will require 184 threads. The number may be increased or diminished by varying the number of repeats of any line or block of the pattern. In making such modifications, the weaver must observe that each time the direction is reversed the first number (1 or 4) is *not repeated* but the sequence of *odd-even* is carefully and continuously maintained. The above pattern is adapted from the Polish Twill and is very attractive

woven in blue on white warp with 20/2 cotton or in linen in a single color.

Further variation is possible through variation in the use of



Courtesy Structo Manufacturing Company, Freeport, Illinois.

ILLUSTRATION 32. Four-harness table loom showing overshot weave in progress.

the weft, as will be very apparent to the weaver who has practiced with the plain twill enough to become familiar with its relationships.

In the loom shown in Illustration 33 the harness frames are metal, each having a flange at the top which catches over the

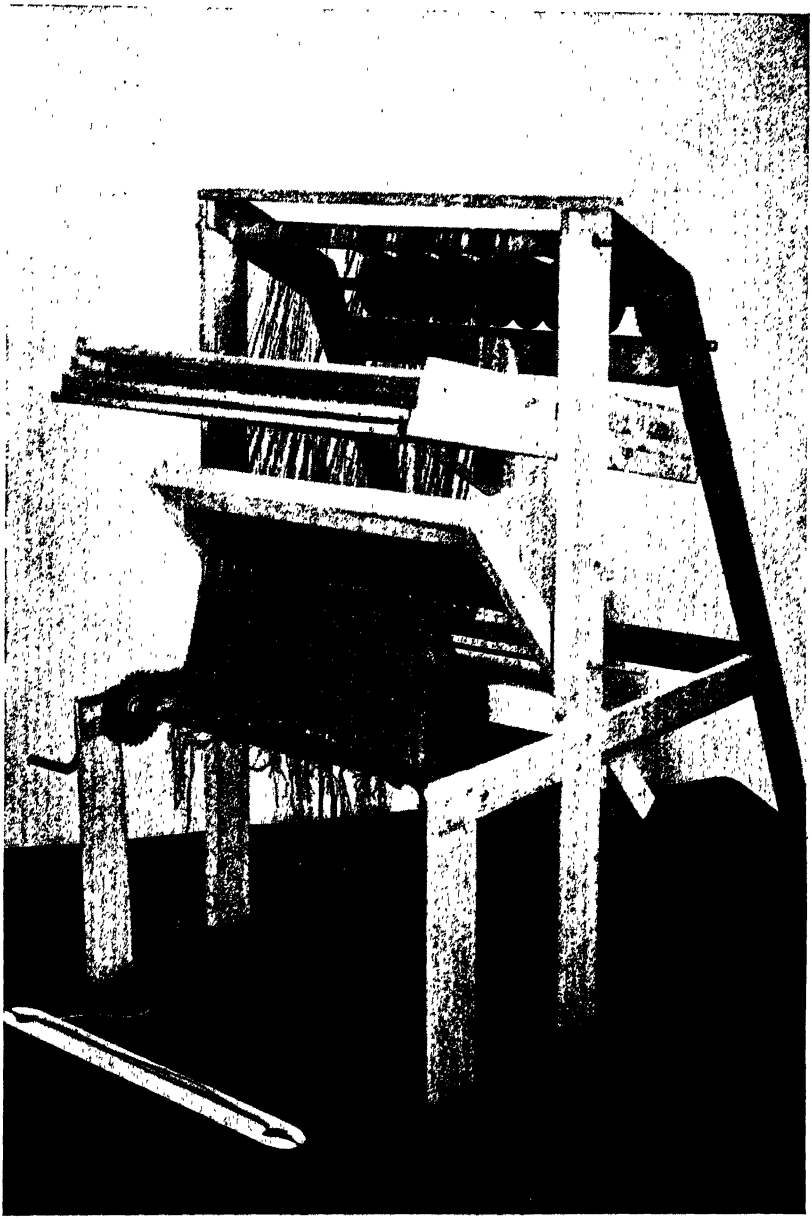


ILLUSTRATION 33. Homemade four-harness loom for hospital use. For description see page 64.

slides and holds the harness in place. The slides in this loom were made by bending galvanized iron strips to a right angle. They could be made with equal or greater convenience by cutting grooves in a thick board. The warp is held in a vertical position, permitting the patient to weave while lying on his back. The beater is weighted at the back and swings on a rod, returning to position as soon as released. The middle leg on each side could be eliminated below the cross bar. Structo Hexagonal warp beams were used on the sample illustrated. These are inexpensive and convenient, but broomstick beams, as shown in the box loom (Illustration 7) could be successfully used.

SETTING-UP A FOUR-HARNESS LOOM FOR OVERSHOT WEAVE

The Overshot Weave

THE overshot weave differs from the twill only in the variation from the 1, 2, 3, 4 order to a *rhythmic irregularity* in the threading of the warp.

The pattern commonly known as the Honeysuckle, is a good example. This pattern requires 26 threads in each repeat, drawn in following the order shown below. The upper diagram gives the pattern as most commonly printed. To help the beginner, a

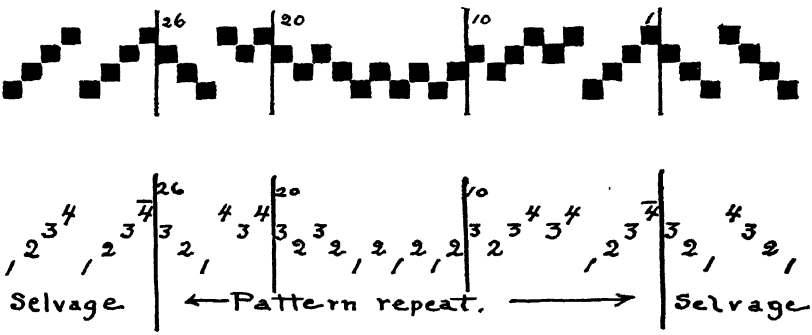


ILLUSTRATION 34. Pattern for honeysuckle weave.

second draft of the pattern is shown, giving the harness numbers. (See Illustration 34.) On examining the draft it will be noted that every other thread—the odds—will be drawn into harnesses one or three; and that the other threads—the evens—will be drawn into harnesses two or four. This makes it possible to produce a plan weave by lifting harnesses one and three together and alternating with harnesses two and four used together.

The repeat of the 26 threads of the pattern is drawn in as many times as required to give the desired width. The selvedge is drawn in once only at each end of the set-up.

Before beginning to draw in the warp, ascertain the number of times the pattern will be repeated in the number of threads to be used.

Note—Structo spooled warp carries 60 threads of the finer warps and 30 threads of carpet warp to the spool. When either is used, calculations must be based on multiples of 60 or 30. If the warp is beamed by the weaver, the pattern repeats should be kept in mind.

The *selvedge* is drawn in once only at each edge of the cloth, that is, at each end of the pattern repeats. The selvedge requires usually the first and last six or eight threads in the set-up. In case the number of warp threads to be used does not divide evenly by the pattern number, a few more threads may be added to the selvedge, provided the order (1, 2, 3, 4) is preserved. This situation often occurs when rethreading for a new pattern without changing the warp.

When fine warp is used it is often desirable to double the warp threads used in the selvedge, drawing in two threads through a heddle. This insures a firm edge in a narrow space.

In threading the Honeysuckle Pattern, as shown in the Illustration on page 65, notice that the harness number outside the long bar marking the end of the pattern is the same as the first number of the pattern. This allows for the repeat without duplication of numbers. (On the second draft this is emphasized by a line over the two fours which begin the pattern repeat.)

This pattern may be slightly shortened without greatly changing its effect by omitting the 1 and 2 in the middle of the draft.

Observe particularly that in the Honeysuckle Pattern and all other patterns given in this book, the odd numbered threads are all threaded through either harness 1 or 3, and that all even numbered threads are in harnesses 2 or 4. This is the most common custom at the present time. There are some old patterns

which are written "1-2 against 3-4" which means that the odds may be in the two front harnesses and the evens in the two back harnesses. When the young weaver progresses far enough to explore old pattern drafts it may be helpful to bear this old method in mind.

Weaving an Overshot Pattern

This process requires two shuttles, one wound with thread like the warp, the other with the pattern color, which should be a heavier yarn.

The weaver should first practice weaving with levers 1 and 3 together, alternating with levers 2 and 4 until able to produce a plain web of even texture and firm edge. The term *overshot* means that the pattern thread *skips over* certain warp threads. This process alone would produce a loose flimsy cloth. To offset this tendency the thread usually like the warp—called the *tabby* or *binder*—is used alternately with the pattern thread making a firm background or body for the material. The *tabby* is woven in regularly—odds-evens—odds-evens—irrespective of the skips made by the pattern thread. It will help the regularity of this process if the weaver notes the direction of the thread in relation to the web, which might be odds, or 1-3, when the shuttle is on the right and evens, or 2-4, when the shuttle is on the left.

The pattern thread is woven in between tabby shots. For the first attempt it would be well to use the same harness for the pattern a number of times. This is less confusing and shows what effect is made by each harness. Each thrust of a shuttle is called a shot. The first attempt might be as follows:

Shots	Levers	
1.	1—3	tabby thread
2.	1	pattern thread
3.	2—4	tabby thread
4.	1	pattern thread
5.	1—3	tabby thread
6.	1	pattern thread
7.	2—4	tabby thread
8.	2	pattern thread
9.	1—3	tabby thread
10.	2	pattern thread, etc.
11.	2—4	
12.	2	
13.	1—3	
14.	3	
15.	2—4	
16.	3	
17.	1—3	
18.	3	
19.	2—4	
20.	4	
21.	1—3	
22.	4	
23.	2—4	
24.	4	
25.	1—3	

This would give three threads for each harness pattern. For practice purpose, however, it is unimportant how many times the same harness is used or whether each one is used the same number of times. The practice should continue till the weaver discovers what happens as the harnesses are manipulated. After using each harness separately for the pattern thread, combinations may be experimented with as 1-2, 2-3, 3-4, 4-1. Since

the tabby thread is used continuously in the same repeat, it is assumed (not indicated) in writing a weaving pattern; only the pattern changes are given. The repeats given above would be written:

3(1)
3(2)
3(3)
3(4)

The Honeysuckle Pattern is very flexible and permits a great variety of combinations. A repeat 1, 2, 3, 4 gives a series of curved lines. Reversing to 4, 3, 2, 1, reverses the curve and makes an interesting figure where the change occurs. The same order, using the same harness two or three times before changing to the next, makes an interesting modification. The beginner should experiment with these shifts until an acquaintance with the nature of the process becomes clear, before continuing one formula long enough to *make something*. The first work will produce a sort of sampler and as the weaving proceeds the weaver should note down, in the form suggested above, the number of times each lever is used. In making such a sampler it will be desirable to weave a plain web, about ¼ inch wide between examples, by weaving with the tabby thread only.

SUGGESTED PATTERN OUTLINES:

a—1(1,2,3,4,3,2) repeated indefinitely.

b—1(1,1,2,2,3,3,4,4,3,3,2,2) repeated indefinitely.

c—4(1)
3(2)
8(3)
3(2)
4(1)

d—2(1)
2(2)
3(3)
6(4)
reverse

e—1(3-4)
1(1-4)
2(1-2)
1(1-4)
1(3-4)
1(2-3)
3(1-2)
3(1-4)
6(3-4)
3(1-4)
3(1-2)
1(2-3)

f—1(3-4)
1(1-4)
2(1-2)
2(2-3)
3(3-4)
6(1-4)
3(3-4)
2(2-3)
2(1-2)
1(1-4)
1(3-4)

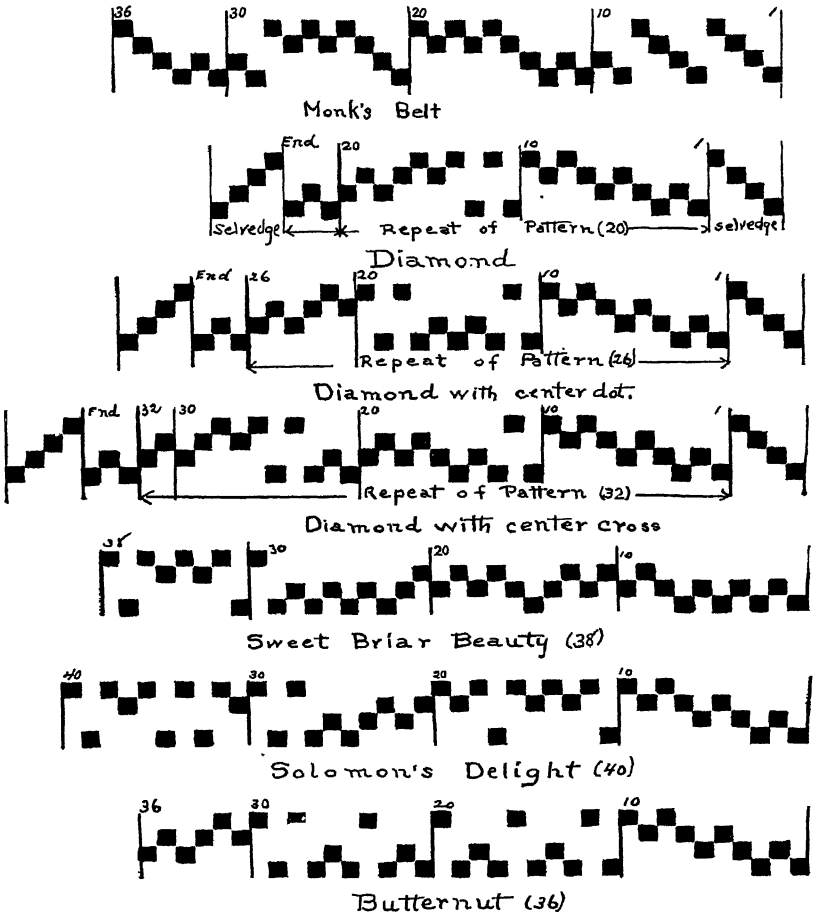


ILLUSTRATION 35. Some simple threading patterns.

WHAT TO WEAVE

WHILE the beginner will really gain time and satisfaction by doing enough experimental work at first to become familiar with the possibilities of his tools and materials, the great pleasure comes through *making something*, especially if that something can be put to immediate use. The following suggestions are offered toward that pleasure.

Articles Possible on a Weaving Frame: plain weave with color variations.

I. *Mats.* Flat rectangular pieces to be used as *table mats, dollhouse rugs, doilies,* etc., may be made with fringe or hemmed.

II. *Bags.* Flat rectangular pieces folded and sewed together to make bags. Size and proportions will vary from small purses and handbags to book satchels and knitting bags. These may be woven with cotton, linen, wool, or silk according to need and purpose. Warp and woof may be the same or other materials may be woven on a cotton warp. Jute makes a strong material for book satchels. Purses and handbags may be finished with or without a lining. They may be fastened with a loop and button; with a zipper; or with snap button fasteners. Very good effects may be secured through attractive color combinations; interesting variations in combination of coarse and fine yarns; and effects in modified designs using stripes and checks.

III. *Cushion covers* require a large square frame but otherwise offer no new problems. The pillows shown in illustrations 4 and 5 were made chiefly of rovings, a soft, inexpensive cotton

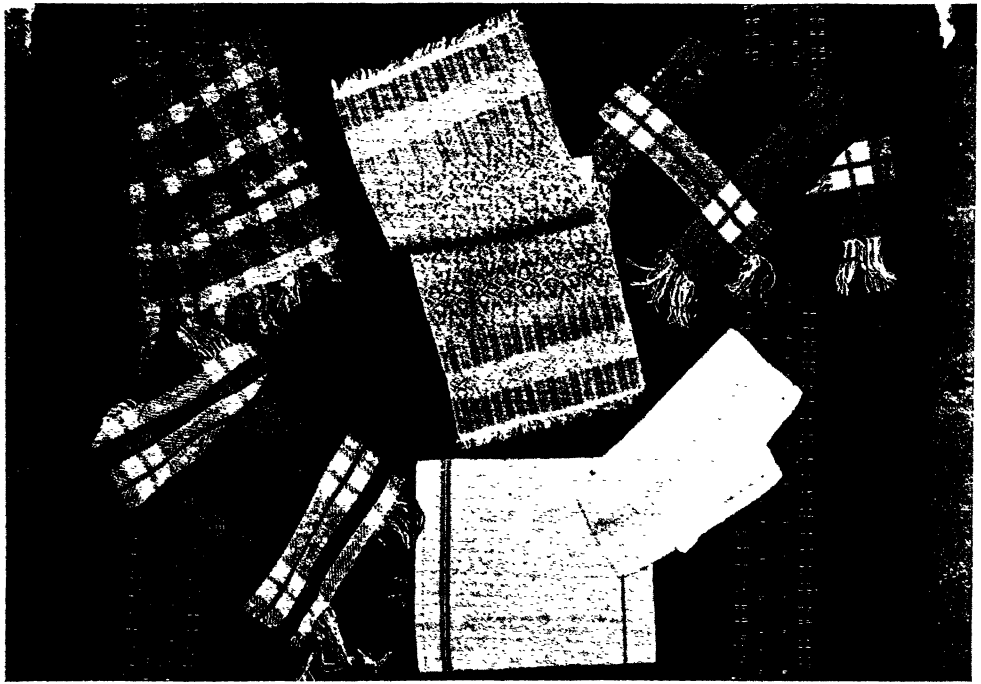


ILLUSTRATION 36. Handwoven scarfs.

yarn about ½ inch in diameter, to be had in a great variety of colors. These were finished with handmade cords made as follows:

For a handmade cord use a piece of yarn a little more than two or four times the desired length of the finished cord. If a color combination is desired, use two colors, half length, tied very firmly together. Two persons may twist this cord simultaneously at each end, or one person may fasten one end securely and twist from the other. Twist the cord until it becomes tight and shows a tendency to twist back on itself.

Next, with the center held by one person or fastened around a hook, bring the two ends together, being careful to keep the cord stretched to its full length. Knot the ends together, release the center and pull through the hands rapidly to secure an even twist.

If four times the desired length has been used, repeat the process, again twisting the cord very tight and doubling it back on itself. Care must be taken not to drop the cord until finished as the ends untwist very rapidly if released.

IV. *Scarfs* are possible if a frame having movable beams is available. Or a short scarf may be woven on a long narrow frame having the desired proportions. A scarf should be soft and filmy and calls for an open mesh. It offers unlimited variation in color combinations.

In Illustration 36 the checked scarf has warp in three colors separated by a single black thread. The weft repeats the colors in the warp. The upper right hand scarf is also plain weave. Both are possible on a box loom. The lower left scarf shows similar color distribution done in twill weave. The center scarf has variation of honeysuckle weave.

V. *Small rugs* may be woven on frames. Those shown in Illustration 5 were made by fourth-grade children on frames 18in. by 36in. These call for widely spaced warp and closely pressed filling. Navajo rugs are made in this manner. However

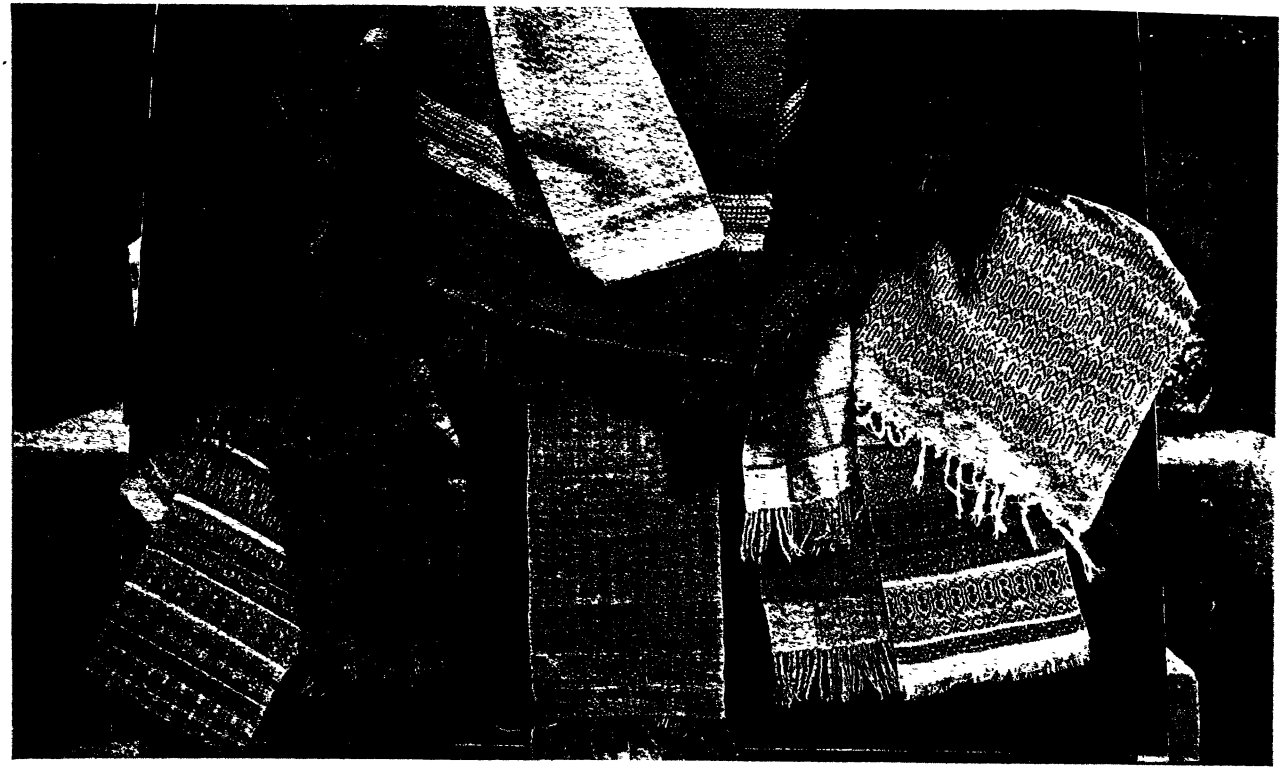


ILLUSTRATION 37. Rug, samplers, and scarfs, by first-semester students in weaving, applied-arts classes, University of Missouri.

the Navajo weaver does not have a frame but only warp tied to a pole which rests in a forked post. The lower ends of the warp are tied to another pole which is heavy enough to pull the warp taut. The weaving proceeds from bottom upward.

If a two-harness loom is available, all of the above articles may be woven more easily and in better quality. The larger loom will probably have greater width, but the two harnesses will permit greater speed by making it possible to weave larger pieces in less time.

Rugs for the floor are easily made from candlewick, rovings, jute, outing flannel torn into strips about one inch wide, silk, wool, or cotton scraps similarly torn.

Rovings is a soft cotton yarn, lightly twisted, and about one half inch in diameter.

Jute is a coarse material similar to hemp, from which gunny sacks are woven.

Candlewick is cheap and may be dyed as desired.

Cushion covers may be woven with spot designs. (See Illustration 20, page 37) or a design may be *laid in.* For a laid-in pattern one or more extra woof threads are laid in with the regular woof and carried back and forth for the short distances of the desired pattern. This extra thread may be continuous or cut off at each shot, leaving short ends on the wrong side.

Scarfs for the neck may be of soft wool or silk.

Table runners may be of linen, wool, or silk.

Luncheon sets. Two long runners or a square center piece and four or more plate doilies with napkins to match may be woven from linen or fine cotton.

Plain cloth in long yardage, sufficient to make a coat or other garment, is also possible for those who have time and interest in that field.

If a four-harness loom is available, there is no limit to the variation in pattern designs applied to all possible uses of cloth.

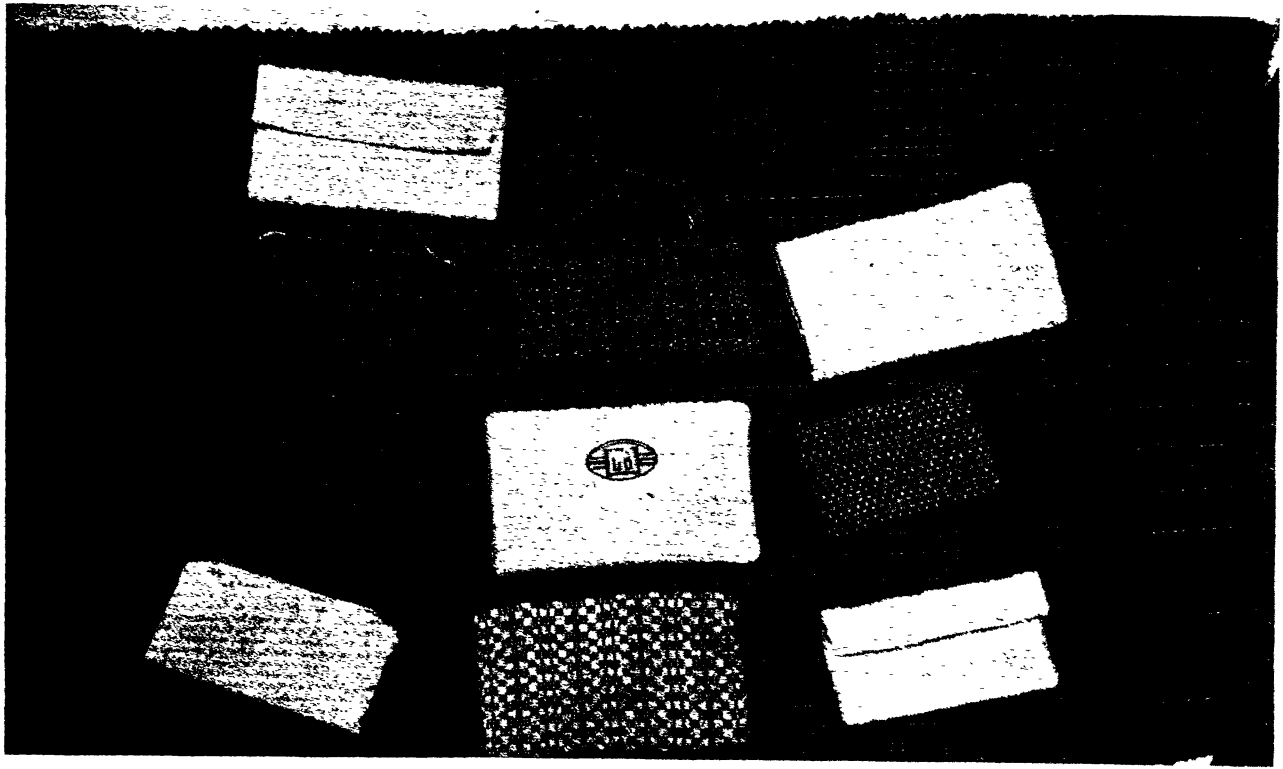


ILLUSTRATION 38. Rug and handbags by first-semester students in weaving, applied-arts classes, University of Missouri.

It is in the infinite possibilities for creative expression that the fascination and satisfaction of the weaving processes are to be found. Even the simple Honeysuckle Pattern, given in the preceding chapter, offers an endless variety of effects through slight modifications in pattern and color. There are hundreds of other patterns and each one may be varied to suit the desire of the weaver. In due time the fuller acquaintance with relationships of warp and woof tempt the weaver beyond the modification of existing patterns into the field of invention of new combinations.

ILLUSTRATION 39. Baby blanket, cushion covers, scarf and handbag, by first-semester students applied-arts classes, University of Missouri.

CREATIVE SELF-EXPRESSION

CERTAIN words and phrases catch the popular fancy and are repeated so often thoughtlessly, that they lose their real meaning. Among these hackneyed words is the term "creative self-expression," used frequently in the foregoing pages.

A weaver, commenting on the variety of things to be woven, said, "It isn't so much what you weave, as what weaving does to you." This comment epitomizes what is meant by *creative expression* as an educational factor.

Too many of us connect the word creative only with the thing made; something new and different; something original, made from nothing and like nothing now existing. This definition is good enough as far as it goes; but going no further, it misses the essence of the thought. It "isn't so much what you make as what the making does to you."

Too often we have thought of education as acquiring information; we say, "I did know that, but I have forgotten." A baby does not learn to talk by merely hearing and understanding words, but by his repeated efforts to use words in *ex*pressing whatever *im*pression they have made upon him. Thoughtful educators are advocating self-expression, not for the sake of what is produced but for the effect upon the producer. The product may or may not have value in itself; but it does measure, quite definitely, the thinking which lies behind it.

Before psychologists helped us to see the importance of the creative factors, we relied chiefly on imitation because, in truth, we learn much by imitating others. We used many *copybooks*, and the copy idea still hampers our growth. Many less thoughtful instructors still see the *product* rather than the *producer*.

Weaving is an educative process because it not only permits but stimulates greatly varied expression. A hundred weavers, starting with the same pattern set-up, will scarcely produce two identical results. Each will modify in some way very similar processes and put himself into his work. Some differences will be incidental or accidental, but they will stimulate real thinking, cause satisfaction or dissatisfaction, and lead to new choices. Through these choices original ideas are born.

This creative factor in weaving, which stimulates thinking and orderly procedure in children's work, serves also as restful recreation for adults who need to forget the cares of the day. As the pattern grows under the hand, the desire to see the effect of just one more thread, leads the weaver on and on with a fascination that excludes all else.

Whether the purpose is helping children to learn to think independently, to give the tired adult a restful experience, to use its therapeutic values for distraught nerves, or to give the artist satisfaction in combining colors and designs, always weaving offers a fascinating medium for creative expression.

It is the purpose of this little book to present the essential mechanical processes of weaving in very clear and simple form and to suggest tools and materials within the reach of everyone.

The homemade box looms, described in the preceding pages, will in themselves prove interesting creative self-expression. There is real fun in setting up simple apparatus and making it work. When a simpler loom has produced a satisfying result, the urge for a better one will be irresistible, and the door will be opened into a world of happy satisfactions through creative self-expression.

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